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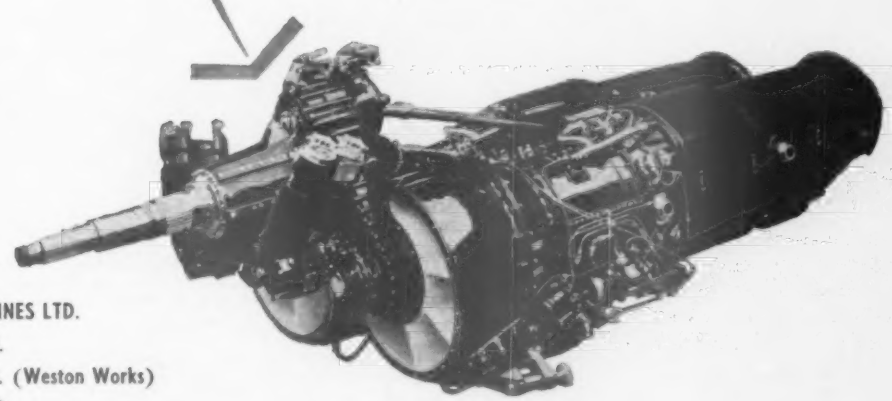

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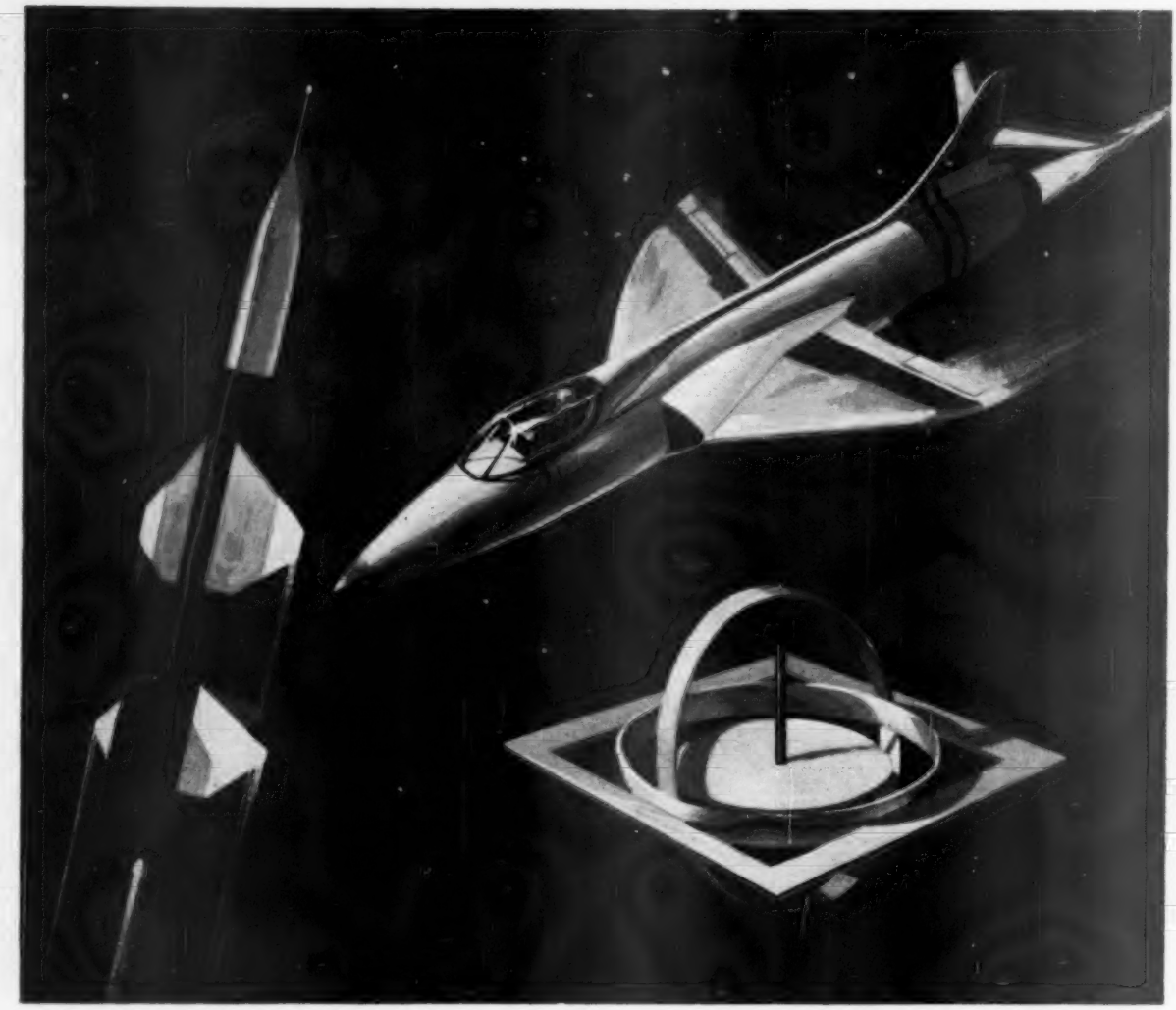

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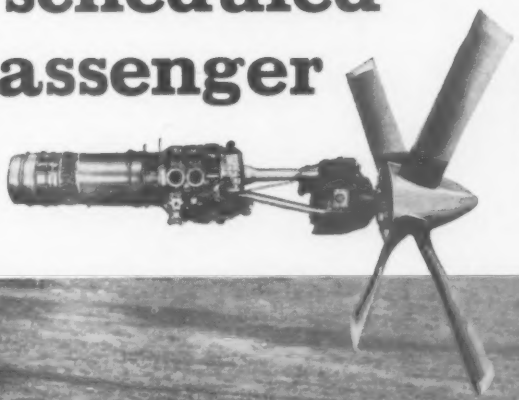
Allison Prop-Jet Convairs to begin scheduled airline passenger service



Allison 501 Prop-Jet engines develop 3750 h.p. and are approved by the FAA to fly 1000 hours before overhaul.

Soon the first U.S. scheduled airline will put Allison-powered prop-jet Convairs into service. This prop-jet aircraft is ideally suited for the routes of this local service carrier, Lake Central Airlines, where flight segments average just over one-hundred miles.

Standard Convair 340/440 aircraft, converted to Allison 501 prop-jet engines and Aeroproducts Turbo-Propellers, cruise at 350 miles per hour—the fastest twin-engine jetliner now in scheduled local service. The Prop-Jet Convair climbs to 20,000 feet from sea level in just thirteen minutes. Its short field performance is exceptional. Full payload range is 675 statute miles—a profitable 550 miles greater than piston-powered Convair 340's.

The Allison Prop-Jet Convairs, now fully certificated by the U.S. Federal Aviation Agency, offer airlines and corporate operators jet-age advantages at lowest initial cost—and even on the shortest flight segments. Route analysis of several airlines reveal this jet-age plane yields 19% to 48% return on invested capital.

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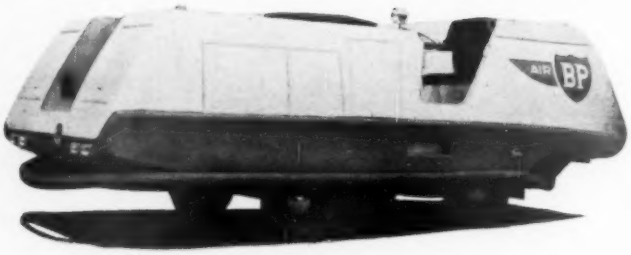

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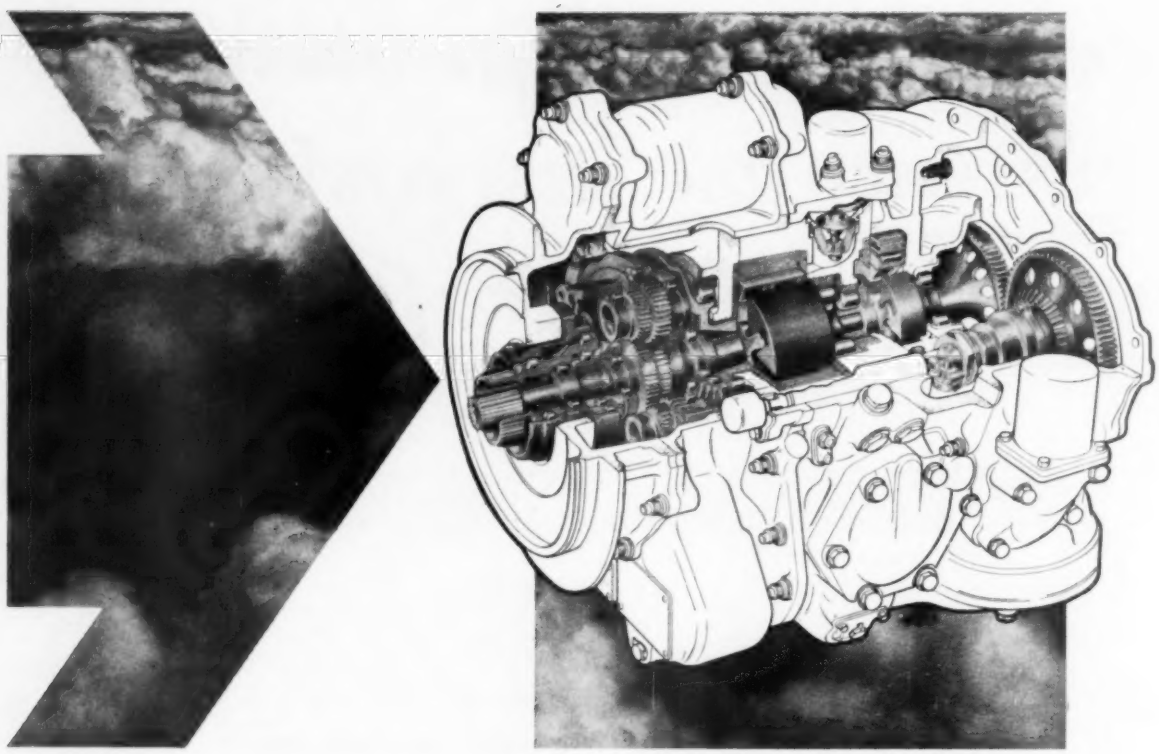

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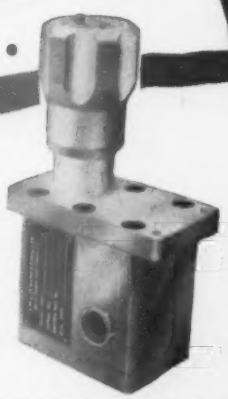

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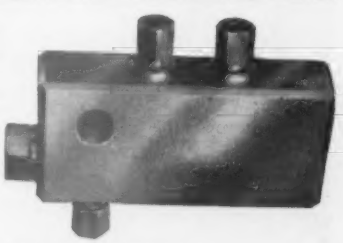

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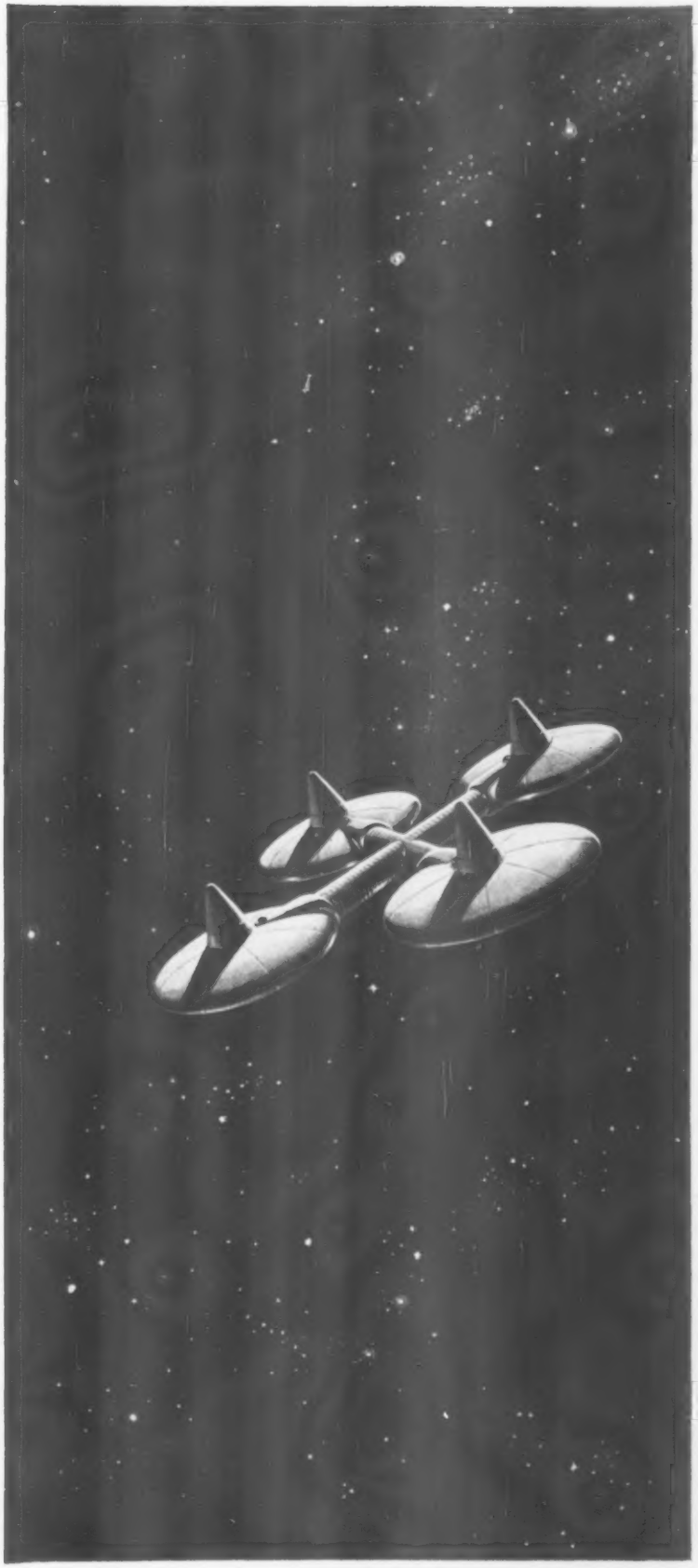

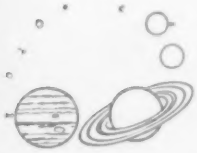

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incorporating SAUNDERS-ROE LTD., FAIREY AVIATION LTD. and the BRISTOL DIVISION

THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2552 SEPTEMBER 16, 1960

Throwing Our Chances Away

Farnborough's annual Show is over; it may well be that the Show of 1960, the year that the S.B.A.C. Flying Display came of age, will count as the year of decision. The next step seems certain to be a discreet loosening of the strict ban on non-British exhibits. It may well be, however, some several years yet before the Show becomes fully international. Therefore the question of whether to hold it once every second or third year is no longer a matter for heated discussion.

It was reassuring to hear the new Minister of Aviation at the S.B.A.C. Dinner undertake to support research. But concerning space little was said. Progress on the supersonic transport seems unlikely to accelerate; it seems certain that talks with the Americans on a combined operation will be pursued more vigorously. In fact, an official announcement following the visit of Gen. Quesada, Administrator of the Federal Aviation Agency in the United States, said that it had been agreed in principle that co-operation in development of a supersonic transport aircraft could be of mutual advantage and should be considered.

Unfortunately, the Minister did not take up Sir George Dowty's plea for a 10-year plan for the Industry, though it was significant that so much emphasis was laid upon this point in the president's speech. Keeping trained teams together without such planning is virtually impossible.

There seems a strange reluctance in the taking of decisions to do with VTOL flight. This 1960 Show will be sure of a place in aviation history for the superb demonstration of complete mastery of mechanical flight. The Short flat-riser showed with absolute convincingness that man can lift himself directly into the air and lower himself back again in a fixed-wing aeroplane of such conventional aspect that it can attain very high horizontal speeds indeed.

This demonstration can only foreshadow the end of conventional airfields as we know them. It must foreshadow the introduction of new forms of traffic control. There can be no escaping the developments that the coming changeover will bring about. Much more advanced engines than those used in the SC.1 are available now, and they no longer rely on conventional materials. Phenomenal performance figures are quoted for engines that deliver 16 times their own weight in thrust.

One might have thought with such achievements, as opposed to projects, to our credit, the Government would have announced a vigorous policy of pressing on with VTOL development. Far from it. It seems content to await interesting developments on the Continent where, using British powerplants, the French and Germans will build their own variants of the Short SC.1 and the Hawker P.1127. It seems hard to believe, but there is a strong view at the highest levels that the first civil supersonic transport, if built in this country, should not have VTOL capability. This can come later. When one considers that informed opinion postpones the introduction of supersonic airliners for 10 years until 1970 one can see that a decision of this nature implies the complete throwing away of our present lead in VTOL flight.

Quos deus vult perdere . . . !

B.

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Matters of Moment

A Useful Accord

BEHIND the careful phraseology of an official communique last week lay news of a most noteworthy decision which may lead to the development of a joint Anglo-U.S. supersonic airliner. This possibility, although often canvassed, had not previously received the open support of either Government; the willingness of both sides now to take at least an initial step towards this goal may well have been influenced by the recently circulated ICAO report (see our previous issue, p. 344) which pointed out the need for massive international co-operation in the development and introduction into service of a supersonic transport.

Talks were held in London last week between a six-man delegation from the Federal Aviation Agency led by the Administrator, the Hon. E. R. Quesada, and a Ministry of Aviation team led by Sir William Strath, Permanent Secretary. Others in the F.A.A. team were Gen. Paul T. Preuss, assistant administrator for plans; Mr. James Anast, director of the Research and Development Bureau; Mr. Oscar Bakke, director of the Bureau of Flight Standards; Mr. Daggett H. Howard, general counsel, and Mr. Ray Malloy, chief of the Office of International Co-ordination. Others representing the M.o.A. included Sir George Gardner, controller, air; Mr. D. W. G. L. Haviland, deputy secretary (C), and Air Vice-Marshal Sir Laurence Sinclair, controller of ground services.

The delegations agreed in principle, said the communique issued afterwards, "that co-operation in development of a supersonic transport aircraft could be of mutual advantage and that further consideration should be given to how this might be achieved." Agreement was also reached to co-operate in the following respects:

(a) the study of air traffic problems in the North Atlantic area;

(b) the development and evaluation of long-range navigation aids;

(c) the study of requirements for, and in the development of, compatible systems of short- and long-distance automatic air/ground data links, and

(d) the completion of arrangements for an evaluation by the Federal Aviation Agency of the automatic landing system, developed at the Ministry of Aviation's Blind Landing Experimental Unit.

Arrangements are also to be made for the exchange of information on research into improved methods of noise suppression, with a view to establishing mutually acceptable standards of noise tolerance.

Space Communications

EARLY development of a World communications system using "active" communications satellites was forecast by Mr. L. Pollack of the International Telephone and Telegraph Corporation in London on Sept. 9. He was speaking at a meeting of the general assembly of the International Scientific Radio Union.

Another attempt to launch the first of three Courier satellites carrying a transceiver and tape recorders would be made within the next few weeks, he said. A first attempt was frustrated on Aug. 18 because of a failure in the first stage of the launching rocket, Thor-Able Star.

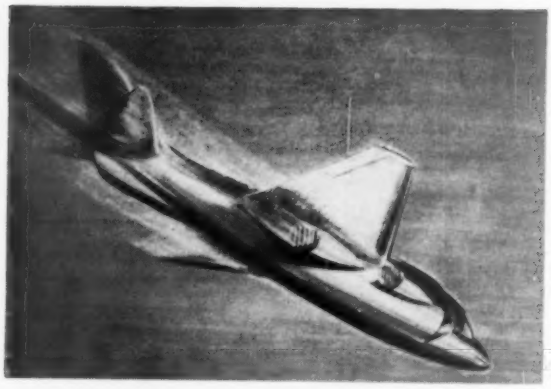
Although Courier is being developed on a military budget under the auspices of the U.S. Army Signal Corps, it has obvious civilian implications. Unlike the 100-ft.-dia. Echo balloon satellite, which serves only as a passive reflector for radio signals, Courier is of "normal" satellite size and capable of handling a much greater volume of more sophisticated radio messages.

The satellite weighs 475 lb., is 51 in. in dia., and can simultaneously receive and transmit stored teletype messages at the rate of 68,000 words/min. Messages are transmitted to the satellite from one ground station, stored on tape recorders, and subsequently re-broadcast when passing over a second station. At the same time, it can receive from the second station a further batch of messages for later transmission. Power supply is 19,152 silicon solar cells which cover about 70% of the satellite's surface.

Mr. Pollack said ground stations had been simulating actual operations for the past two months. During the first experiment, two stations would be linked, one at Ponce, Puerto Rico, and the other at Deal, New Jersey. Courier I is intended to operate from an orbit bringing it over mid-Atlantic at the same time each day and will be capable of handling 960 voice channels. Eventually, it is hoped to link Eastern America with Africa and Western Europe.

Two other satellites would be needed to operate over the Pacific and Indian Oceans respectively. In this way, said the speaker, a World system of channel allocation could be arranged based on linking small as well as large countries where "growth in communications has been hampered by national barriers."

Cost of the first satellites would be nearly 30 million dollars apiece. During the first 10-year period of an operational system, all would be replaced four times at an additional cost of 16 million dollars a year, Mr. Pollack concluded. "But it is estimated that the gross income will be about 80 million dollars a year. The system will certainly pay for itself and suggests a strong possibility of a substantial reduction on the charge for messages before long."



This artist's impression on the Bristol Siddeley stand at Farnborough, removed soon after the S.B.A.C. display opened, was generally considered to show the Hawker P.1127. More details are on page 406.

A VTOL Argosy

SEVERAL interesting Argosy developments are under review at the present time, and brief mention of one of these was made last week at Farnborough. Intended for military use as an assault transport, this would have two Tyne engines in the inner nacelles and the outer Darts would be removed in favour of two underwing pods each containing 20 Rolls-Royce direct-lift engines to give the aircraft VTOL capability. In each long pod the engines would be grouped in two banks fore and aft so that they would provide lateral and longitudinal control at zero forward speed.

The lift engines (RB162s according to one report) in an installation of this kind might be expected to develop a total thrust of about 130,000 lb., and the max. aircraft weight would then probably be in the region of 110,000 lb., compared with the 97,000 lb. of the military A.W.660 at present under development. Most of this extra 13,000 lb. in gross weight would be accounted for by the weight of the 40 lift engines (some 8,100 lb.), the pods and the fuel needed for take-off, so the operational payload would not be altered significantly.

While this project is entirely a military one at present, it would be of significance commercially if it were to be built, since it would provide a genuine transport test-bed for VTOL operations using separate lift and thrust engines. Military experience of this type of operation would doubtless be required before commercial applications could be considered.

A Boeing Swallow?

A VARIABLE-SWEEP tactical-fighter project has been announced by the Boeing Airplane Co. It is stated that this "versatile fighter airplane which could fly more than twice the speed of sound yet operate effectively under short landing field conditions has passed its major design tests." It could be operational by 1965. The design has been under study for more than 2½ years and a proposal will be submitted to the U.S.A.F. this autumn to meet a Tactical Air Command requirement.

The aircraft would be powered by two turbojets or turbofans in the 15,000-lb. thrust class and would be able to cruise supersonically at tree-top level as well as at altitude. It would probably have a crew of two seated in tandem.

For supersonic cruise, this new Boeing aeroplane would have a modified delta wing with a span of 33 ft. For take-off, landing

and subsonic cruise wing sweep would be decreased to give a straight wing with a 67-ft. span. It will be possible to hold the wing sweep at any angle between the unswept position and the " almost wingless semi-delta shape " used for supersonic cruise.

Flying at subsonic speed the aircraft would have an unrefuelled range allowing it to cross the United States non-stop. Flying above Mach 2 its range would still be greater than that of current fighters and it would have a much better low-altitude range and penetration. For reconnaissance it would have a loiter capability. The aircraft could carry bombs, missiles, rockets, gun pads and reconnaissance equipment.

It would seem that this project bears a close resemblance to the variable-sweep Swallow concept of Dr. Barnes Wallis. Work on this project is being continued in Britain under the aegis of the British Aircraft Corporation.

Serving an Industry

GROWING in strength, the German aircraft industry increasingly makes its mark in Western European affairs. For that reason it is interesting to know something of the history of the president of the Bundesverband der Deutschen Luftfahrt Industrie (B.D.L.I.) (the German S.B.A.C.), Dr. L. S. Rothe.

Chairman of the board of Messerschmitts, Dr. Rothe will be 60 on Sept. 26. His experience of aviation goes back to 1933, when he was in charge of the aviation side of the engineering firm of Henschel and Son. During the War years he was chairman of Junkers.

After the War he was among the first to campaign for the lifting of the ban on German aviation, and rebuilding of the aircraft industry: he was elected president of the embryo B.D.L.I. in 1954, and since then has put the full force of his personality into the practical rehabilitation of his country's aircraft industry.

As an experienced industrialist Dr. Rothe realized from the beginning that it should forget its former scale, and reorganize according to present national potential. He early advocated specialization and close association of the different firms, as well as joint contracts with foreign firms then 10 years ahead in technical know-how, to build, as a first step, aircraft such as the Fouga Magister, Fiat G.91 and Lockheed Starfighter under licence.

As chairman of Messerschmitts since 1957, he has put his ideas into practice (his own firm operating jointly with Heinkels) securing within AICMA agreements which place the German industry on a sound and promising footing *vis-à-vis* their foreign partners, in both the production and the research fields.

Dr. Rothe adds membership of the Council of the D.V.L. and other scientific bodies to his activities. His wide knowledge and experience together with the esteem he enjoys in Germany and abroad have contributed in no small measure to the re-establishment of the German aircraft industry.—D.S.

Remembering the Battle

FOR the past 12 years the work of relieving the distress of all those who suffer because they, or a member of their family, gave life or limb in the Royal Air Force, has cost the R.A.F. Benevolent Fund £1,600 a day; and the money so spent has exceeded income by £594,418. Since its foundation in 1919, the Fund's work has accounted for over £9¼ million.

In stating these facts recently, Lord Knollys, chairman of the Fund, also stressed the point that those who fought in the 1939-45 War are now at least middle-aged, and many will soon experience the troubles and difficulties that old age so often brings. As a result, the Fund must not only undertake its present work but prepare for increasing responsibilities in the time ahead.

Those who wish to express their gratitude for the past 20 years of freedom since the Battle of Britain are asked to send a donation to the R.A.F. Benevolent Fund at 67 Portland Place, London, W.1.

SHOW STEALER.—Most significant of all the items displayed at this year's S.B.A.C. Display, the Short SC.1 settles back vertically on to the runway after a stimulating performance. It is powered by five Rolls-Royce RB.108 turbojets—four providing vertical thrusts for VTOL and one for forward propulsion.

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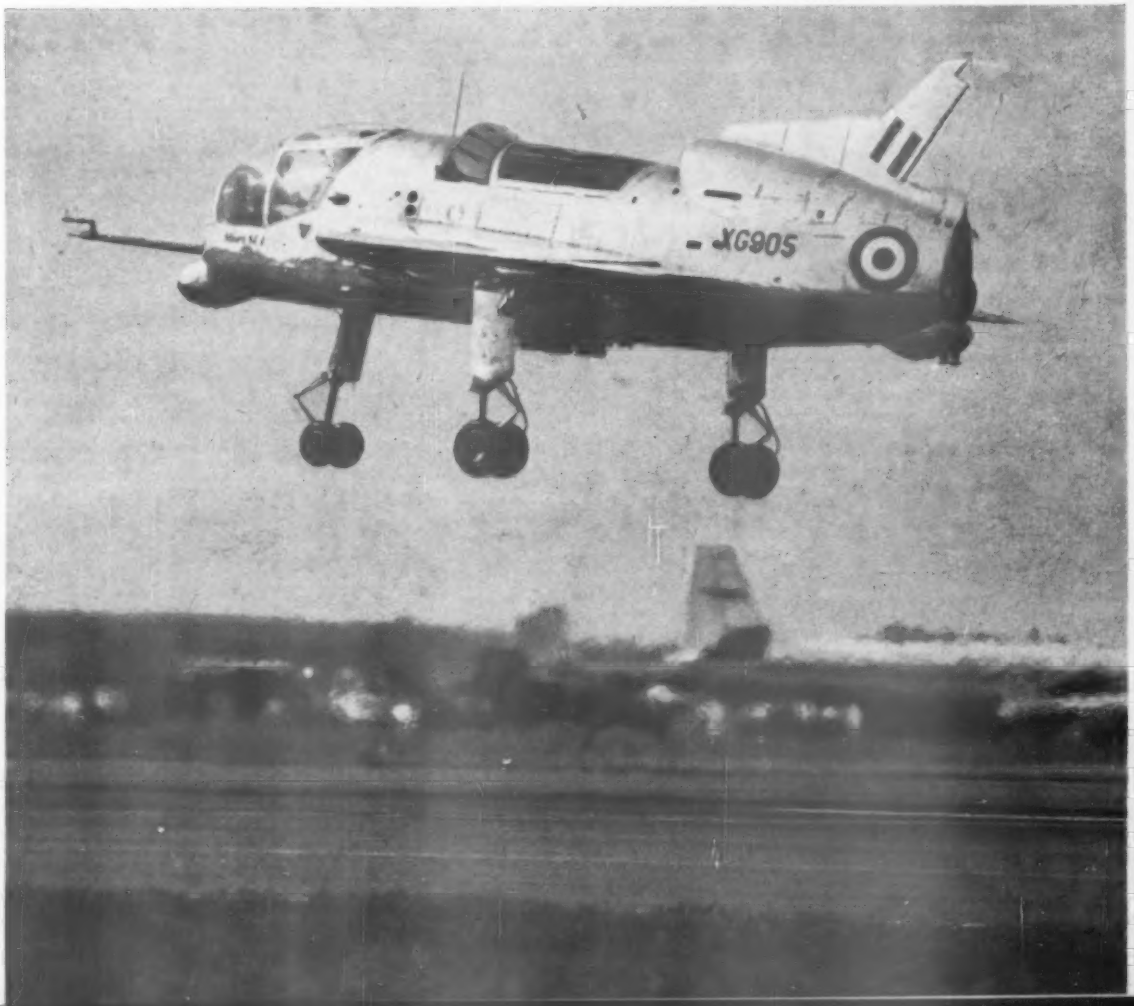


Report from Copenhagen

DELEGATES to the 16th Annual General Meeting of IATA were welcomed in Copenhagen on Sept. 12 by Mr. Ake Rusck, president of the Scandinavian Airlines System in the presence of Their Majesties King Frederik and Queen Ingrid of Denmark and of His Royal Highness Prince Axel of Denmark.

Mr. Ake Rusck, whom Sir William Hildred described as one of the youngest men ever to preside over IATA's deliberations, had the pleasant task of introducing the Prime Minister of Denmark, Mr. Viggo Kampmann. He emphasized that the necessary conditions for a continued healthy progress in air transport would be the carrying out of a liberal policy.

He referred to the uneasiness with which those in the North had noticed the considerable restrictions which had been imposed upon the traffic rights of companies. These had meant a break in the efforts at liberalization made by the aviation companies since the end of the last War, both in the multilateral and bilateral sectors.

The retiring president of IATA, Seijiro Yanagito, president of Japan Air Lines, drew a moral for all to understand when he noted that the air transport industry, reflecting the interest of men of every origin and of nearly all the nations of the World, had been able in such a short time to launch the present jet age without malice, without rancour and without bloodshed. The answer, he said, was simple and obvious. The coming into being of the jet age afforded conclusive proof that men of goodwill working together with goodwill could accomplish anything they set out to achieve. He too submitted that there must be freedom of the skies everywhere.

At the end of the day the executive announced its plan to tackle the outstanding problem of air transport, the "processing" of passengers and goods. To study the problem and recommend practical solutions, a ground-handling advisory group has been formed comprising members from 12 airlines from Europe, North America, Australia and the Far East. Priority is to be given to accelerating passenger check-in methods and baggage handling. Attention will also be given to the development of an integrated air cargo handling system.

And finally, the executive committee recorded the thanks of IATA for the valuable services rendered the Association by J. W. S. Brancker as traffic director over the period of seven years, which ended on Jly. 31, 1960.—T.J.

Rotorcraftmen's Annual Dinner

SUBMERGED though the identity of the Helicopter Association of Gt. Britain may be under the somewhat colourless designation of the R.Ae.S. Rotorcraft Section, the spirit that pioneered the helicopter and its vigorous association in this country was triumphantly conspicuous at the annual dinner held in London on Sept. 8. Some five hundred members and guests gathered for the occasion at the Dorchester.

The aviation people in this country owe the helicopter fraternity a debt of gratitude; the gathering is a social affair and graced by the presence of wives and daughters. In consequence the occasion has become an enjoyable affair much looked forward to. Strangely enough, technical and business matters are not overlooked. Maybe, the Royal and aged parent body may learn to take a leaf from its youngest section's book; there are not enough social affairs in aviation these days.

Speeches at the Helicopter Dinner, if we may be forgiven the anachronism, are designedly short; even if on one memorable occasion a speaker bolted as it were with the bit between his teeth. This year DR. MOULT, president of the R.Ae.S., proposed the health of the new section in warmly welcoming terms. He presented the Alan Marsh memorial medal to Flt. Sgt. B. Breach and the Alan Marsh memorial award to Mr. A. C. Jolly.

PROF. J. A. J. BENNETT, chairman of the Rotorcraft section, replied. He later proposed the health of the guests. To this toast, MR. M. D. N. WYATT, chairman and managing director of British United Airways, replied.

Aviation News in General

GLIDER AEROBATICS. — The National Glider Aerobatic Contest for 1960 will be held at the London Gliding Club, Dunstable Downs, on Sunday, Sept. 25, between 11.30 and 16.30 hrs.

CLOSED CIRCUIT RECORD. — A U.S. Navy McDonnell F4H-1 Phantom II flown by Lieut.-Col. T. Miller, U.S. Marines, averaged 1,216.78 m.p.h. over a 500 km. (310 mile) course at Edwards Air Force Base on Sept. 6. This performance is being submitted to the F.A.I. as a new record; the existing 500 km. record is held by a U.S.A.F. RF-101 at 816.3 m.p.h.

JETSTAR TRIALS.—First flight of the first production Lockheed JetStar was made recently. This civil model of the executive transport has a standard fitting of 500 U.S. gal. glove tanks on the wings; larger tanks will be used on the five ordered by the U.S.A.F. with the designation C-140. Four flying and one static test JetStars will be used in the F.A.A. certification programme, with the sixth airframe scheduled to be the first delivered to a customer—Continental Can Co.—early next year.

NOW THE JET PUMP.—Described as a jet pump aircraft, a new VTOL project by Lockheed Marietta has a vertical duct through the fuselage, with doors at the top and bottom. Two turbines in the wing roots provide conventional jet thrust for forward flight; for VTOL, the jet stream is diverted downwards into the fuselage chamber. This high velocity jet draws a large volume of air down through the top doors, to produce a relatively low velocity air stream.

FRENCH TYNES.—Rolls-Royce and Hispano-Suiza have ratified a licence agreement for joint production of the Tyne turboprop. This engine will power two new European aircraft, the Breguet Atlantic and the Transall C-160.

CANADIAN TURBOPROP. — The Canadian Pratt & Whitney PT-6 turboprop will be flight-tested this autumn in the nose of an R.C.A.F. Beechcraft Expeditor. The engine is designed for the expanding executive market. The Aero Commander and the new Beechcraft Queen Air are designed for pressurization and possible conversion to turboprop power.

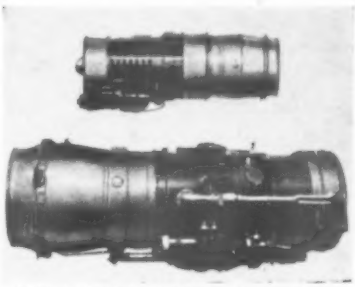
AUTO STABILIZATION.—A Westland Skeeter helicopter is being used for tests of Louis Newmark auto-stabilization equipment, and not of Elliott equipment as stated in our issue of Sept. 2.

DOWTY GROUP BUSINESS. — Orders for aircraft accessory equipment worth nearly half a million pounds have been received by Dowty Rotol during recent weeks. Products involved include Jet Provost landing gear; Fiat G-91 fuel

POTENTIAL PUNCHES.—Loads for the Saab Draken—Left to right: 400-kg. drop tank, rocket pod with 19 x 7.5-cm. AAMs, Sidewinder AAM, 500-kg. bomb, 250-kg. bomb, six 13.5-cm. RPs, three 80-kg. flash bombs, 30-mm. cannon, AAM rocket pod, drop tank, Sidewinder, and a ventral drop tank. Similar equipment is on the right of the aircraft.

flow proportioners; VC10 ram air turbine equipment; and similar equipment for the D.H.121. The company has also concluded a 10-year agreement with Hispano-Suiza—the French company will manufacture the Dowty Rotol gearbox for the Tyne engines of the Breguet 1150 maritime reconnaissance aircraft.

ROLLS-ROYCE LATEST.—Illustrations of two new military Rolls-Royce turbojets, the RB.153 and the RB.168 by-pass engine which closely resembles the civil RB.163, have now appeared. These indicate the layout of the new engines but are not fully accurate representations of them. The RB.153 is the subject of an agreement between Rolls-Royce and the German company M.A.N. Turbomotoren.



MILITARY TURBOJETS.—New military engines from Rolls-Royce are the RB.153 (top) and RB.168; both are described above.

GNOME H.1400. — de Havilland Engines have given the following figures for the H.1400 up-rated version of the Gnome turboshaft engine: five-minute take-off and 30-min. contingency rating. 1,440 s.h.p.; one-hour rating, 1,400 s.h.p.; max. continuous rating, 1,175 s.h.p., at s.f.c. 0.62 lb./s.h.p./hr.

PIONEER VI.—An Atlas-Able three-stage rocket is scheduled to launch Pioneer VI into orbit around the Moon on or about Sept. 22. A similar payload was launched, unsuccessfully, on Nov. 26 last year.

SATELLITE ELECTRONICS.—Electronics package developed by the Guided Weapons Division of Bristol Aircraft Co. for the University of Leicester's solar X-ray experiment in the first Anglo-American Scout satellite is regarded as particularly advanced for its power consumption. It is contained in a 3-in. stack of 5½-in.-dia. printed cards; consumption is 80mW.

MONKEY SATELLITE.—Within the next few weeks, two Discoverer satellites are expected to be launched from Vandenberg A.F.B., Cal. Recovery of re-entry capsules will be attempted over the Pacific Ocean, near Hawaii. First capsule will carry instruments, the second a spider monkey.

TRANSATLANTIC ECHO. — Engineers from the G.P.O. and the Royal Radar Establishment, Malvern, succeeded on Aug. 29 in receiving signals at Malvern reflected from the satellite Echo I. Signals, which included both unmodulated carrier waves and speech transmissions were transmitted from the Bell Telephone Laboratories at New Jersey, U.S.A. Receiving antenna was only 20 ft. in diameter.

FIRST FIRING.—Launching site for the Minuteman ICBM is nearing completion at Cape Canaveral. It consists of two "open" launching pads, two blockhouses, two 90 ft. deep "silos" and facilities for storage, assembly and maintenance. First open-site firing, scheduled for December, will include three "active" stages. Next will come "silo" shots and then test-launchings from a mobile train also at the Cape.

HUNTING AIRCRAFT BOARD.—All the formalities in the British Aircraft Corporation's take-over of a controlling interest in Hunting Aircraft, Ltd., have now been completed. Sir George Edwards and Mr. W. Masterton have been elected to the board and Mr. G. L. Hunting and Mr. R. R. S. Cook have left it. The board is now: Sir Percy Hunting, chairman; Sir George Edwards, C.B.E., B.Sc., Hon. F.R.Ae.S., Hon. F.I.A.S., vice-chairman; Mr. W. A. Summers, C.B.E., F.R.Ae.S., M.I.Prod.E., managing director; Mr. K. D. Morgan, F.C.A., secretary and commercial director; Mr. F. W. Buglass, M.I.Prod.E., works director; Mr. F. H. Pollicutt, F.R.Ae.S., A.F.I.A.S., technical director; Mr. C. P. M. Hunting, T.D., B.A., F.C.A.; Mr. L. C. Hunting, M.A.; and Mr. William Masterton, C.A.

Commercial Aviation Affairs

THE QUEBECAIR 540s.—The two Canadair 540s which, as we reported last week, have been purchased by Quebecair, are the two 440 airframes in which Canadair installed Eland turboprops before starting production of the 540 proper. They were delivered to the R.C.A.F. on lease for crew training at the beginning of 1959.

GERMAN AIRLIFT.—Silver City Airways has been awarded the first Government contract for air-trooping between Britain and Germany. Starting on Oct. 3, about 50 Hermes flights a month in each direction will be made, using Manston as the U.K. base for the operation.

CARAVELLE TOUR.—The S.A. Caravelle destined for General Electric has completed a tour of 18 cities in the U.S. and Canada in the course of which 66 demonstration flights have been made and 1,700 passengers carried. It was flown by Douglas pilots, and is now to have CJ-805-23 turbofans fitted as a prototype for the Caravelle VII.

T.W.A. COMING UP.—On the basis of revenue passenger miles flown, T.W.A. claims to be the second largest world airline. In the year ended Jne. 30, over 5,478 million rev. pass. miles were flown, compared with American Airlines' total of 6,336 million. United Air Lines was in third place.

ATLANTIC FARE REQUEST.—The American Society of Travel Agents has again asked the U.S. Civil Aeronautics Board to support the introduction of year-round North Atlantic excursion fares of £107 and £116. The lowest present economy fare is £160 15s. and there is to be a 17-day (October-March) excursion fare of £114 by propeller aircraft or £124 by turbojet.

SWISSAIR IN THE CONGO.—Between Jly. 18 and Aug. 23, Swissair operated 14 flights between Europe and the Congo and 19 in the Congo itself in response to a request from the U.N. Secretary-General. In 500 flying hours, Swissair carried 520 passengers and over 225 short tons of supplies.

COLLEGE OF AIR TRAINING.—The first group of 21 cadets have now started their courses at the College of Air Training, Hamble. The group joined the College yesterday, Sept. 15.

JETS WANTED.—According to Mr. Robert I. Helliesen, president of Aircraft Exchange, "substantial member organizations" of the Exchange are seeking to buy two DC-8s and three Boeing 707s for early delivery. Substantial earnest money deposits are offered before negotiations start.

INTERLINE CLEARING.—In the first six months of this year, the IATA Clearing House in London settled an estimated 31% more inter-airline business than in the first half of 1959. A total sum of over £235 million was cleared, with the offsetting of counterclaims in over 44 different currencies representing 89.4% of this total.

TRAINING AT SHANNON. — B.O.A.C. is to move its Boeing 707 training activities from St. Mawgan, Cornwall, to Shannon Airport in mid-October. This will follow completion of runway extensions at the latter airport.

SUNBIRD SERVICES. — T.A.A., which took over on Sept. 1 from Qantas all internal Papua-New Guinea services, has adopted the name Sunbird for these services. Aircraft on these routes—six DC-3s and four Otters—are to be painted in a new bright colour scheme.

NOT SO CHEAP.—Pan American Airways informs us that the offering price of the seven DC-4s for sale at Frankfurt (our issue for Aug. 26) is $200,000, rather than the $60,000 which we reported from a local source.

B.O.A.C. RESIGNATION. — Capt. T. H. Farnsworth, who has been chief of flight operations for B.O.A.C. since 1959, is resigning from the service of the Corporation when a successor has been appointed. Capt. Farnsworth joined Imperial Airways in 1936 and since 1945 has been closely concerned with the service development of new B.O.A.C. aircraft.

ARGENTINE ACCIDENT.—25 passengers and a crew of five were killed when a DC-6 of Aerolineas Argentinas crashed on Sept. 7. It was flying from Asunción to Buenos Aires and crashed near the border at Salto during a severe storm. Some reports indicate it may have been struck by lightning.

HELICOPTERS INCREASE. — The number of commercial helicopter operators in the U.S. and Canada has nearly doubled (from 99 to 193) in the past three years, and the helicopters in commercial service increased from 470 in 1957 to 705 in 1960. New uses are being discovered, with jobs ranging from placing power line poles to carrying tourists over the battlefield at Gettysburg.

Back From Orbit

PICTURES have now been released in Moscow of the container in which the two dogs, Strelka and Belka, were recovered from orbit on Aug 20. One is a photograph of the actual container mounted on a handling trolley, another a cutaway drawing illustrating some of the equipment, and third a diagram of the re-entry path. They are reproduced here.

Despite this information, however, much still remains obscure, particularly data concerning the method of recovery. The Russians have stated that the pressure cabin containing the animals was catapulted clear of the spacecraft after re-entry "as a safety measure" and that both components landed in good condition.

The pictures appear to show only the bio-capsule section of the recovery vehicle, which accounts for some 2½ tons of the total 4½-ton payload. Features of the catapulting mechanism—including small wheels which presumably run on rails in the body of the spacecraft—are seen in the diagram, but there is no reference to the recovery parachute. It would appear that the other section of the vehicle contains the retro-rocket and orientation system, together with a separate parachute system.

If the Russian diagram of the re-entry trajectory is to scale, it is evident that the spacecraft covered a greater distance during re-entry than did the capsules of the American Discoverer satellites which were "cut-down" from orbit by retro-rocket over the North Pole and recovered near Hawaii. In the Russian case, it seems that re-entry may have been triggered from the Soviet Antarctic base at Mirny to effect a landing in the central U.S.S.R.

Needless to say, for the Russians to achieve recovery—as they have stated—only 6¾ miles from a designated point, purely by ballistic means, presupposes tracking and control accuracies of a high order. Prof. Ari Sternfeld has been quoted as saying that "smaller retro-rockets" were used to correct the flight path during re-entry.

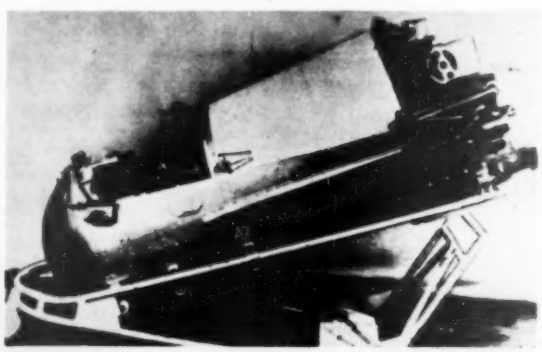
This also prompts the question of whether lifting surfaces were employed to convert an initial ballistic path into a controlled glide before the two sections of the spacecraft divided for final parachute recovery. Questioned on this possibility at the I.A.F. Congress in Stockholm on Aug. 19 (the day of the launching), Prof. A. Blagonravov replied that further information would be given during the course of the experiment.

Whatever the answers may be, it is clear that the Russians are keeping back a good deal of information concerning this pioneer experiment.—K.W.G.

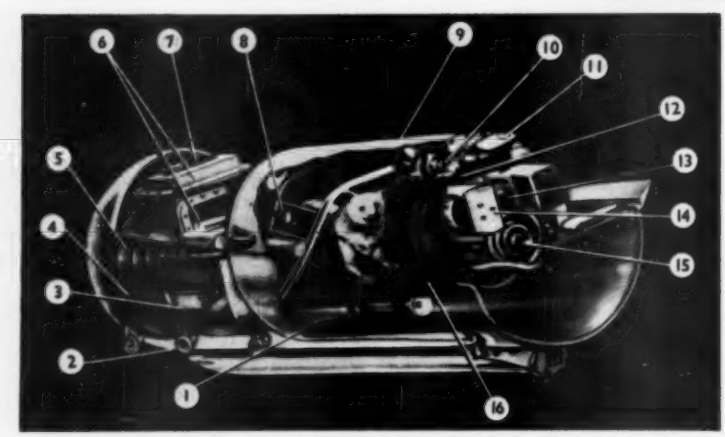
Re-entry diagram. (1) Retro-rocket fires against the direction of motion. (2) Descent trajectory. (3) Region of recovery.

SPUTNIK V.

Launched :	On Aug. 19, 1960, believed from Aralsk, near the Aral Sea.
Payload :	10,143 lb.—not including final-stage carrier rocket.
Orbit :	Near-circular, apogee 210 miles, perigee 190 miles.
Inclination :	64° 97.3' to plane of equator.
Period :	90.72 min., diminishing at rate of 0.0003 min. per 24 hr.
Test-animals plants, etc. :	Two dogs, Strelka and Belka, 40 mice and two rats ; fruit flies, plants and fungi ; microscopic water plants ; and some seeds. (After recovery, animals, and insects reported normal ; a flower in the cabin was still blooming.)
Scientific apparatus :	Instruments for measuring light and heavy nuclei in primary cosmic rays ; ultra-violet radiation from the sun ; and for detecting amounts of radiation in animal compartment. Blocks of thick photographic emulsions were carried, total weight about 132 lb.; one block developed in orbit.
Communications :	Radio operating on 19.999 Mc/s., and comprehensive telemetering equipment. Television used for direct observation of test-animals in orbit.
Recovered :	Aug. 20, on the 18th orbit after travelling nearly 500,000 miles. Landing reported in a meadow 6¾ miles from designated point in undisclosed region of U.S.S.R. Total time in orbit approximately 24 hr.
Launching vehicle	Multi-stage rocket of unspecified size, probably in 800,000 to 1,000,000 s.t. class. Same type vehicles test-fired into Pacific Ocean with dummy final stages earlier this year ; similar vehicle launched Sputnik IV. (10,010 lb.) on May 15, 1960.



Part of Sputnik V showing the pressure cabin, top right, which contained the two dogs.



A Russian drawing showing the pressure cabin and "catapulting container" in which the two dogs were returned from orbit. (1) Air supply cylinder. (2) Catapult firing mechanism. (3) Radio direction-finding block. (4) Special storage battery for heating test glass with microbes. (5) Storage battery. (6) Special scientific equipment. (7) Catapulting mechanism. (8) Movement mechanism. (9) Pressure cabin. (10) Microphone. (11) Direction finding aerial. (12) Intake/exhaust valves. (13) Television camera. (14) Mirror. (15) Ventilator. (16) Automatic feeding device.

Air Transport

Argosy C. of A. Trials Complete

ARMSTRONG WHITWORTH announced last week that the Argosy has "now completed all tests to the satisfaction of the Air Registration Board to enable the operator to obtain a full C. of A. for the aircraft in the transport category (passenger) for World-wide operation. This also covers carriage of freight."

Contractual negotiations, say A.W.A., covering the first batch of 10 civil Argosies, are also nearing completion. These contracts, we understand, will cover the sale of seven aircraft to Riddle Airlines, Inc., and the leasing of three to B.E.A. A letter of intent covering the first five Argosies was signed by Riddle on Mar. 15, and a down payment was made to Armstrong Whitworth after the company had concluded a contract with MATS on Jne. 17 for a Logair "outsize cargo" domestic scheduled air freight operation (our issue Jly. 8). The cost of purchasing the five aircraft, with engines and parts, was said by the airline to be approximately $9 million.

For the purchase of Argosies, Riddle has set up a wholly owned subsidiary in Puerto Rico, to secure equipment trust loans from American and British financial interests. The aircraft will be leased from this subsidiary company for a sum equal to the repayments due on the loans. The two extra Argosies, for the acquisition of which a further $2 million is being raised by the company, will allow additional MATS contracts to be undertaken.

The situation over the three Argosies for B.E.A. is less certain at present, but recent reports have suggested they will be operated by Skyways on a European freight network on behalf of B.E.A. The Corporation explained in its recent Annual Report and Accounts that the Argosy might produce greater freight capacity than B.E.A. really needs in the next few years, when the coming into service of Vanguards and Tridents will in itself lead to a very big increase in the amount of freight space on passenger services.

Heralds for Jersey

JERSEY AIRLINES' order for six Handley Page Heralds, announced last week at Farnborough, is the first unequivocal airline backing for the Dart-engined version of this now thoroughly developed branch-liner. As such, it may mark the start of an upswing in the Herald's fortunes. Prospects of other sales being concluded in the near future seem to be good, especially in South America where, as we recorded on Jly. 1 (p. 3), letters of intent covering 16 aircraft have been obtained from airlines in Brazil and Argentina. The Brazilian orders, including one from VASP for seven Heralds, will, it is hoped, be concluded soon after elections have been held in that country next month.

The choice of Heralds by Jersey Airlines followed evaluation of this and other turboprop feeder-liners, including the Avro 748 and Fokker Friendship. According to Mr. M. L. Thomas, the airline's chairman and managing director, none of the types evaluated "showed such a high profit-potential as the Herald over our short stage lengths. These average only 100 naut. miles. I have been particularly impressed by the proving of the Herald on the most difficult air routes of more than 50 countries. Their servicing record on these trips has been remarkable. This is the aircraft our pilots, maintenance people and passengers need—we are looking forward to operating this fine airliner."

The Jersey Heralds will have a longer fuselage than the version flying at present, with an extra 42-in. extension forward of the wing. This allows the maximum accommodation to increase to 56, but the Jersey version will seat 48-50 and will have a galley. Although the basic operating weight of the longer Herald will be greater than at present, the take-off weight for Jersey Airlines will remain at 39,000 lb., allowing the full payload to be carried over the comparatively short sectors from Jersey to Paris, Dinard, St. Brieuc, Guernsey, Gatwick, Southampton, Bournemouth, Manchester, Coventry and Exeter.

No difficulty is anticipated in certificating the Herald at 40,000 lb. or more in due course. Tropical trials, Handley Page said last week, have shown that certification will be obtained for the 39,000-lb. weight in temperatures up to I.S.A.+30° C. at sea level, compared with the I.S.A.+22° C. which had previously been expected. Up to I.S.A.+13° C., 40,000 lb. can be used without further development, and an increase in landing weight to 39,500 lb. will be possible with minor modifications.

Delivery of the first Herald to Jersey is promised for next June. According to the makers last week, this will follow production of the three for B.E.A. which are now being assembled at Reading. These, it will be recalled, were ordered by the Government a year or so ago for B.E.A. to operate on certain Scottish routes, as a means of providing some tangible encouragement for the aircraft. Since then, B.E.A. has shown no great eagerness to introduce the Herald, although this is no reflection on the aircraft as such. No mention of plans for the use of the type is made in the latest B.E.A. Report and Accounts, and the definitive contract has not yet been signed. If other airlines follow the Jersey lead, it seems possible that B.E.A. may relinquish its Heralds, or perhaps allow them to be operated by Jersey Airlines, in which B.E.A. has a 25% interest.

Avro 748 Tally

AFTER a five-week period on the ground for a maintenance Check 1 and the introduction of various modifications, including adjustments to the flying controls, the Avro 748 prototype G-APZV resumed its test-flying programme on the last day of August. It flew down to Farnborough on Sept. 4 for the S.B.A.C. display and, after making its public debut on Sept. 5, was flown for a final check by the A.R.B. before the Special Category C. of A. was issued. The latter was granted to the Avro 748 on Sept. 6, by which time total hours flown since the first flight on Jne. 24 were nearing 70.

Orders for the Avro 748 now stand at 12, B.K.S. having become the "major shareholder" in this total with five. The B.K.S. option on three, announced a year ago together with the initial order for two, was taken up last week. Skyways will still be the first customer to take delivery of an Avro 748—in mid-1961—with B.K.S. next. Both Skyways and Aden Airways have ordered three, the Aden aircraft being Series 2s for 1962 delivery. Making the total up to 12 is one complete Avro 748 Series 1 for the Indian Air Force, now in process of unassembled delivery to India, where it will be put together at Kanpur prior to a start being made there on production of a military version. A Ministry of Aviation contract for three (offered a year ago when the Ministry ordered three Heralds) is still being negotiated, with a likelihood that R.A.F. Transport Command will be the recipient of these particular aircraft.

Middle East Comets

THE first Comet service in Middle East Airlines' colours will be flown on November 1, some two months earlier than previously planned, under a chartering agreement between M.E.A. and B.O.A.C. M.E.A. has chartered two Comet services a week from November 1 to the end of March, 1961, on the route London—Rome or Geneva—Athens—Beirut—Dhahran.

The services will be operated by B.O.A.C. crews with M.E.A. crews and cabin staff flying as supernumeraries under training. The Comets will be flown in temporary M.E.A. markings, but the agreement covers services rather than aircraft so that maximum reliability is ensured.

Training of M.E.A. crews in the U.K. has already begun, and its continuation on the chartered services should reduce the amount of route proving and training flights necessary after the first M.E.A. Comet 4C is delivered on Dec. 15. Regular services with this 4C are scheduled to begin on Jan. 6, 1961, and all four aircraft should be in service by April 15.

Introduction of the Comets will lead to some adjustment of the M.E.A. fleet, but present plans call for the retention of at least four of the seven Viscount 754s for use on local routes in the Middle East.

SIMPLE SKYVAN.—A feature of the Short Skyvan (see our issues for Aug. 26 and Sept. 2) is that it is suitable for single-pilot operation despite its high standard of flight equipment. This view shows the left-hand seat and central console carrying the radio controls.

Air Transport . . . .

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Operating Profit or Loss (U.S. $ millions)	−120	−49	−9	+41	+24	−13	−3	+32	+78	+84	−41	+15	+140
Per cent.	−10.3	−3.5	−0.6	+2.7	+1.3	−0.6	−0.1	+1.3	+2.6	+2.5	−1.0	+0.4	+3.1

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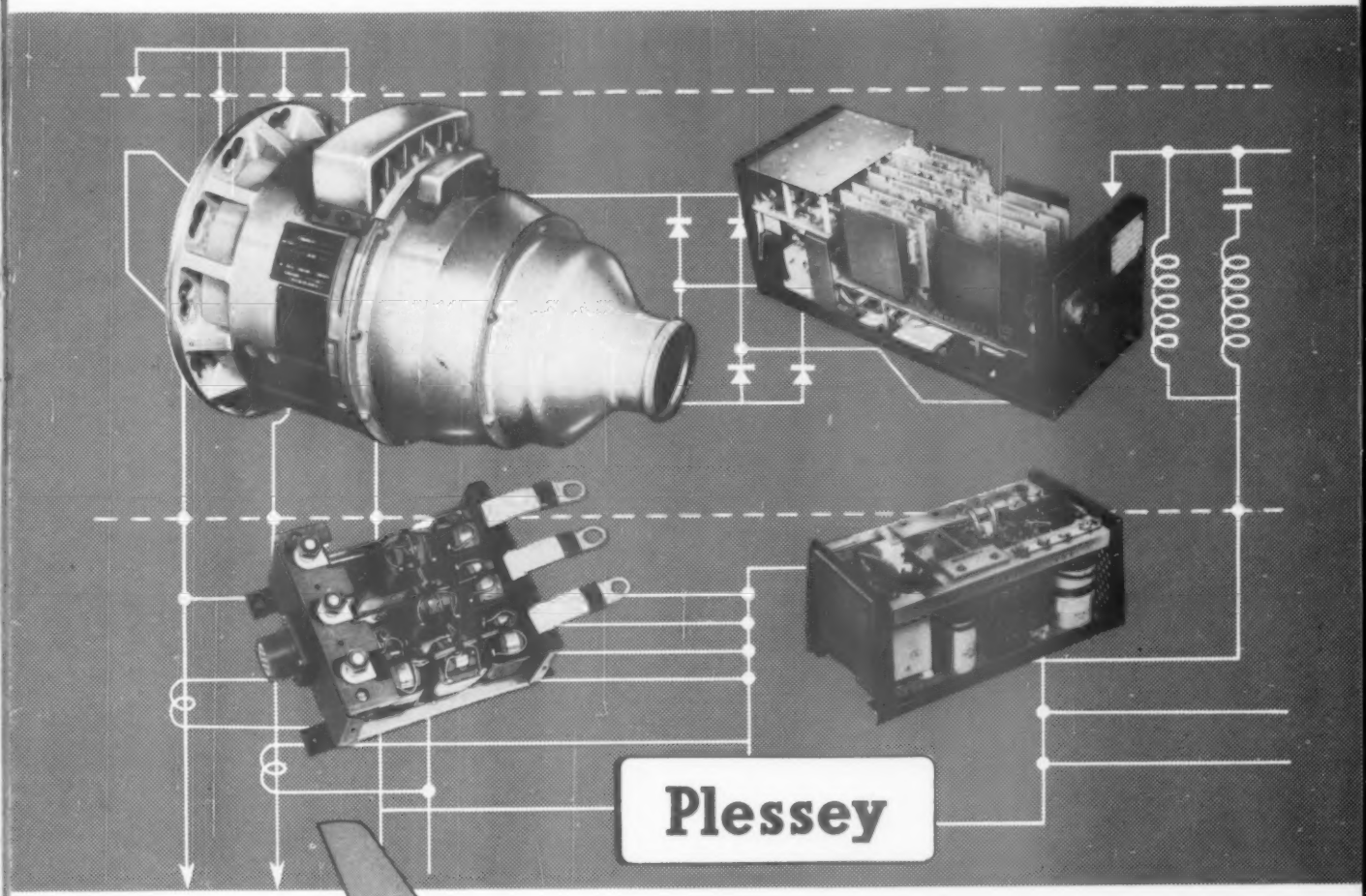
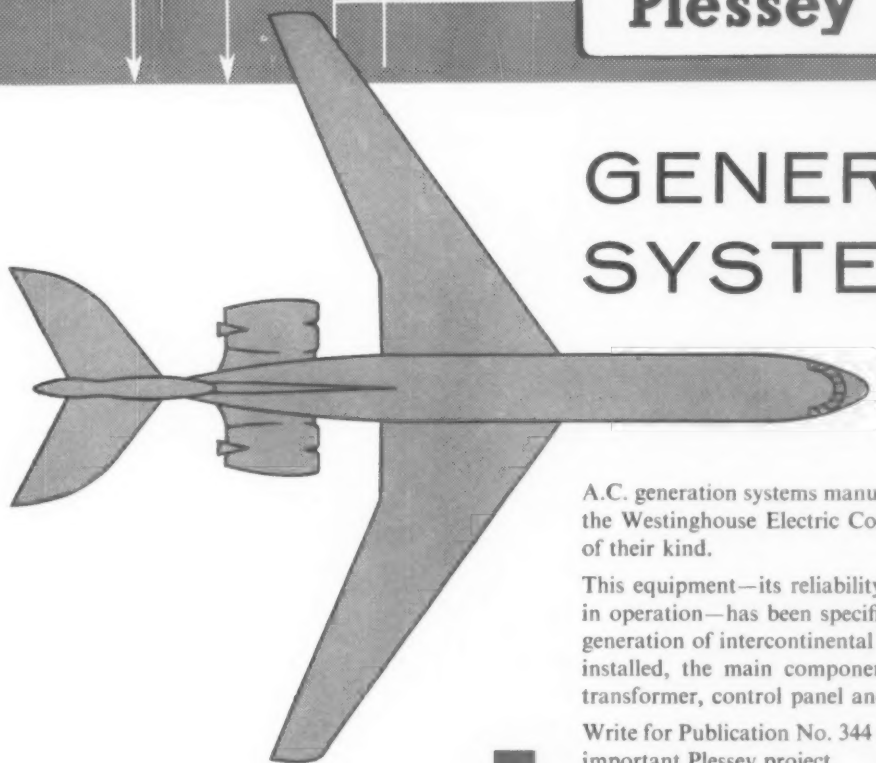
Another **Plessey** contribution to a.c. techniques



GENERATION SYSTEMS



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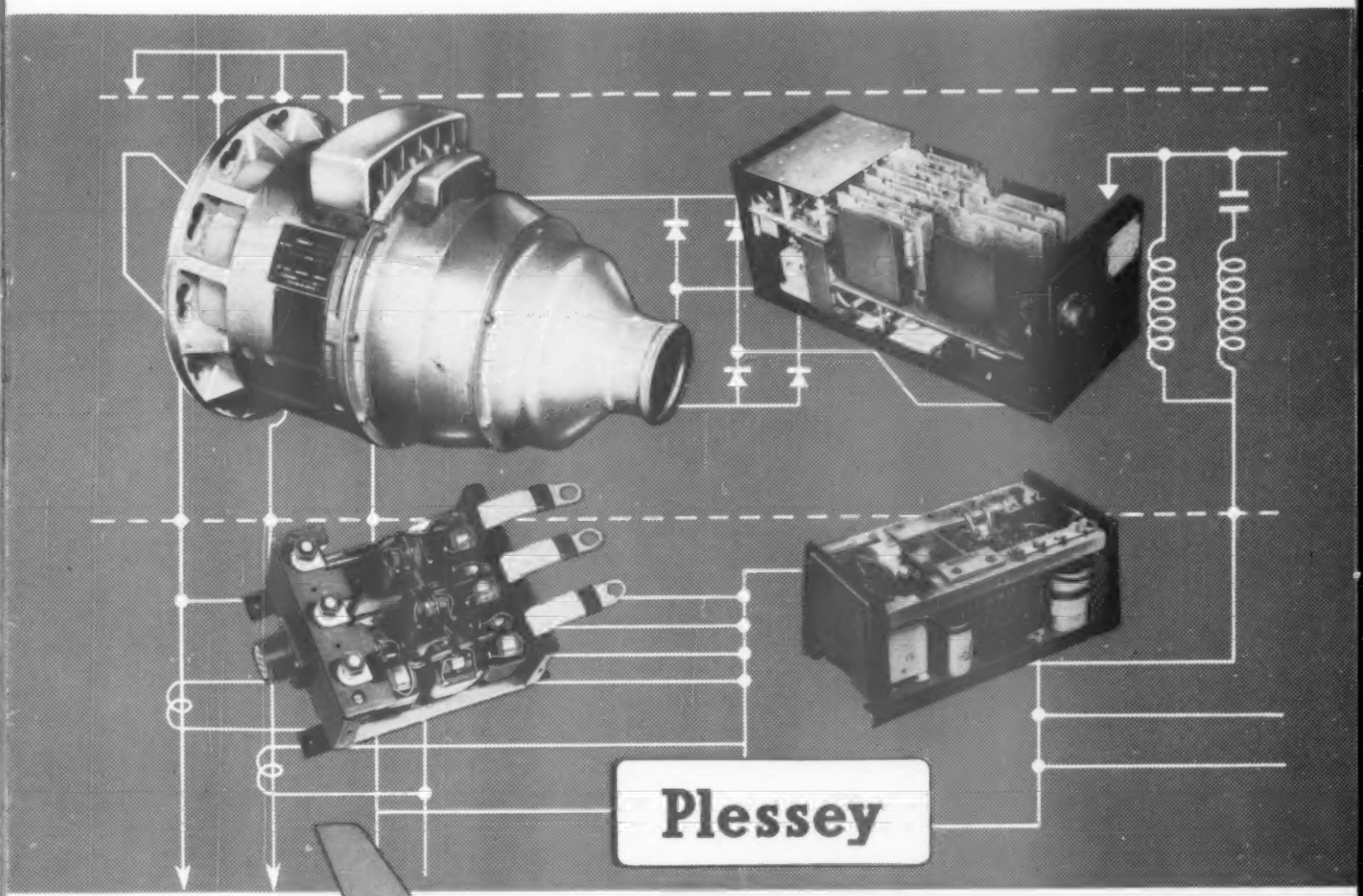

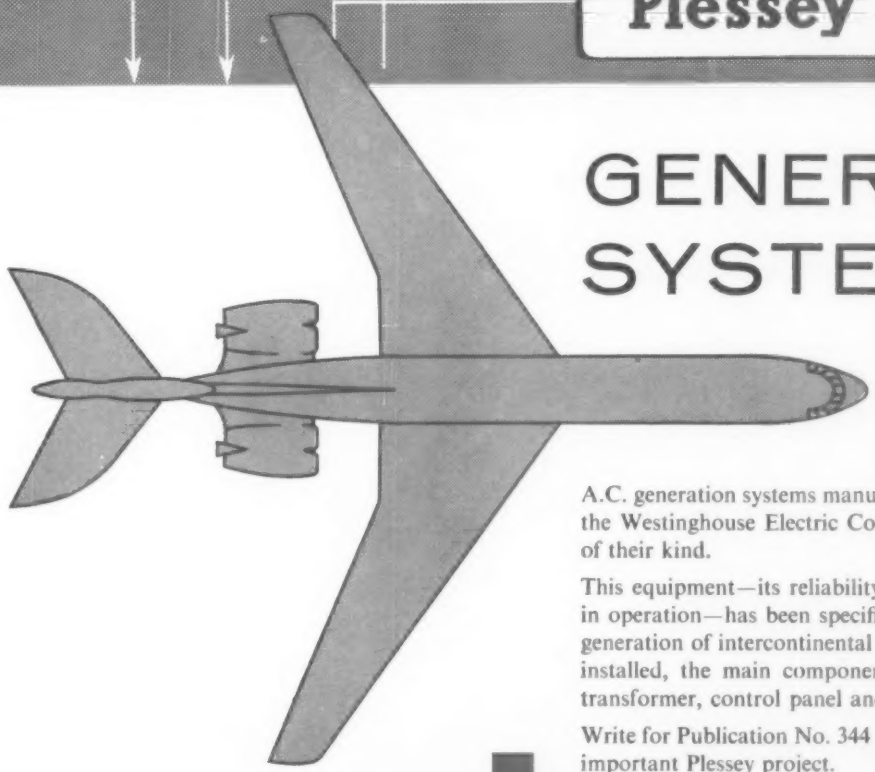

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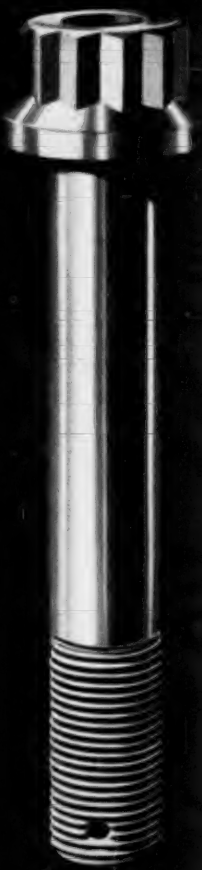

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Air Transport . . . .

North Atlantic Traffic

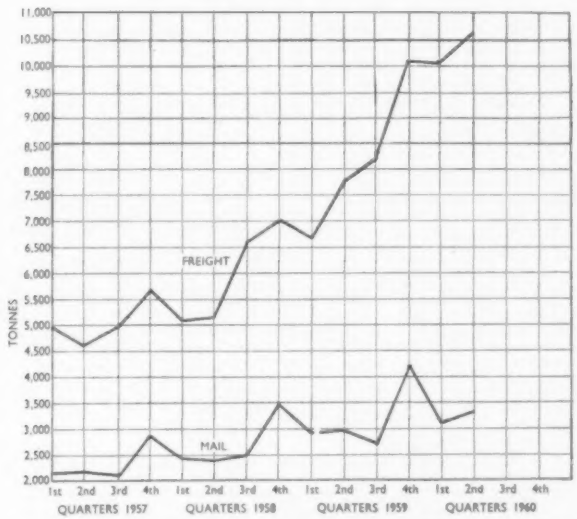
TOURIST-CLASS traffic across the North Atlantic, in the final three months of its existence, fell to 0.9% of the total. This is one of the facts made clear in IATA statistics for North Atlantic traffic in the second quarter of 1960, summarized in the table and graphs below. A year ago, 17,087 passengers, or 4.5% of the total, flew tourist class; this year, the tourist total was 4,373. First-class traffic gained slightly during the quarter, but another big jump in economy class was chiefly responsible for the overall 26.8% gain in the number of passengers travelling.

The rapid build-up of jet equipment on the North Atlantic route, and the swing towards higher seating densities, was reflected in the 20% increase in seats offered, for 554 fewer services flown. The overall load factor of 70.9% hides the directional nature of the traffic. Monthly passenger load factors ranged during the quarter from 53.3% westbound to 90.4% eastbound in June; the highest individual class load factor was 94.5% for economy seats, also eastbound in June.

Freight traffic reached a new high level with a healthy 37.9% improvement over the second quarter of 1959. Of the 10.6 million kg. total, 6.2 million was carried on 6,893 passenger flights and 4.4 million on 802 all-cargo flights. 2.8 million kg. of the mail was also carried on the passenger flights.

SECOND QUARTER, 1960.

	Eastbound	Westbound	Total	% change on 1959
Scheduled flights	3,886	3,809	7,695	− 6.7
Seats offered	340,341	334,957	675,298	+20.7
Revenue passengers :				
First	49,747	37,425	87,172	+ 5.3
Tourist	2,519	1,854	4,373	−74.5
Economy	232,019	155,187	387,206	+39.6
Total	284,285	194,466	478,751	+2[illegible].8
Pass. load factor (%)	81.8	58.6	70.9	+ 3.4
Freight (kg.)	5,109,773	5,549,937	10,659,710	+37.9
Mail (kg.)	1,871,665	1,450,730	3,322,315	+15.2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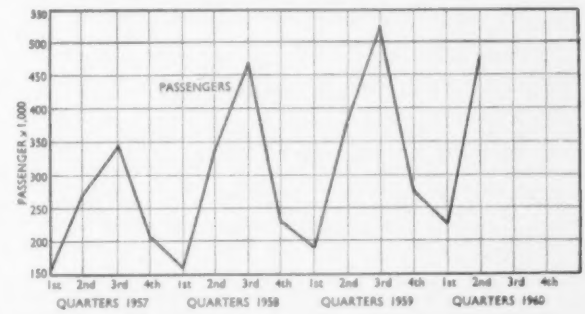
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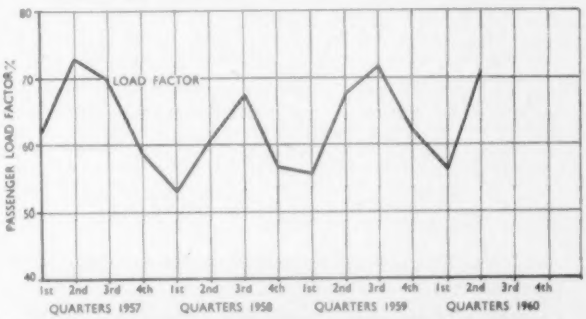
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QUARTERS 1957 QUARTERS 1958 QUARTERS 1959 QUARTERS 1960

FLYING BUSHMAN.—A new view of the Max Holste Super Broussard on one of its early test flights (see our issue for Aug. 12). Wheel housings have since been added.

The Fighting Services

R.A.F. Air Display in Malta

TO mark the 20th anniversary of the Battle of Britain, the Royal Air Force, Malta, held an air display on Aug. 27 at the Ta Qali airfield. Ta Qali is besides Luqa the only other operational airfield in Malta and, in addition to being the home of several units, includes the Malta Communication and Target Towing Squadron equipped with Valletta, Devon and Meteor aircraft.

The display took place in blazing Mediterranean sun before a crowd estimated to have been about 30,000. Watching the display were many important island personages, amongst whom were the Governor, Sir Guy Grantham, who gave the order to scramble the four Hunter Mk. 6 fighters from No. 92 Sqn. led by Sqn. Ldr. R. Dixon, and so open the afternoon's flying programme.

The vast crowd regarded the afternoon as packed with thrills. They were treated to some grand flying demonstrations by Hunters, Valiants, Vulcans, Meteors, Canberras, Shackletons, Britannias, Comets, Vallettas, Beverleys, Chipmunks and Hastings. For the more curious and air-minded who like to examine aircraft from close quarters there was also a static display of most of the aeroplanes mentioned. A good many items of airborne and ground equipment were exhibited in a hangar, along with one of the survivors of the gallant company of "Faith," "Hope" and "Charity," the three Gloster Gladiators which were the sole air defenders at the opening of the Battle of Malta in 1940. In this hangar the public saw the Fairey Fireflash air-to-air missile.

Following the opening of the afternoon's display with the fighter scramble by Hunters, Shackletons of No. 38 Squadron gave a demonstration. A Meteor Mk. 8 piloted by Flt. Lt. Turner gave the first aerobatics solo display of the day. A Valletta flew past on a solo run and the public were asked to judge the height.

The peace of the airfield was then shattered when two Canberras from Tactical Air Force, Germany, gave a low-altitude simulated bombing display in the new style. A Varsity aircraft then showed in a fly-past the more sedate style of flying. The quiet was again rent when amidst a growing crescendo four Canberras from No. 39 (P.R.) Squadron made a drill take-off from the aerodrome.

A demonstration fly-past of jet and piston aircraft by Comets, Britannias and Vallettas came next, followed by a perfect display of formation flying and stream landing by four Canberras. Afterwards a Valletta and a Hunter teamed for a comparative speed run over the airfield. The Hunter, piloted by Flt. Lt. G. Aylett, did solo aerobatics with four-point rolls and four upward rolls, leaving traces of white trail behind. To provide the lighter side a Chipmunk did some crazy flying.

ARMY AVIATION.—On Sept. 5, Maj.-Gen. E. F. Easterbrook, Commandant of the U.S. Army Aviation Center, visited the Army Air Corps Centre at Middle Wallop. He is seen here with (back row, left to right) Maj. S. Whitehead, Capt. P. Child, Capt. J. F. Tippen and (front row) Maj. H. B. Warburton and Maj. P. Richardson, all of whom have completed the U.S. Army transport helicopter course.

LATEST ADDITION.—The R.C.A.F. recently acquired its first DHC-4 Caribou from de Havilland Aircraft of Canada. This STOL transport is to be operated in support of the Canadian Army contingent in the Congo.

Multi-jet Valiants from No. 207 Sqn. did a scramble take-off and demonstration, to be followed by dummy paratroop drops by Beverley aircraft and supply demonstration by Hastings aircraft. Afterwards No. 101 Sqn. provided the thrill of the afternoon with their Vulcans.

An attack on a fortified position on the airfield made plenty of noise and smoke when Meteors, Canberras and Shackletons pasted Ta Qali fort with Royal Malta Gunners defending. A Beverley landed commandos to assault the fort.

The public stood transfixed on their seats to see the grand finale of the afternoon—formation flying by Hunters from No. 92 Sqn. The display came to an end when these five Hunters swooped on the airfield and broke up formation, leaving trails behind them in a majestic bomb-burst.

A. J. LEAVER.

Winter Sports

THIS winter the R.A.F. Ski and Winter Sports Association is again organizing cheap, friendly and excellent ski-ing holidays around the slopes of the Matterhorn, at Zermatt, in Switzerland. During the 1959 season the Association—which for some years now has been encouraging Service people, including families, to learn to ski—helped over 1,000 of its members to visit Zermatt.

For about £50 per person, the Association organizes a 16-day holiday (14 days' ski-ing) with all expenses covered. Credit payment facilities are available once a booking has been made and the journey from London can be made by either train/boat or train/air.

Further details may be obtained from the honorary secretary of the Association, Sqn. Ldr. D. E. K. Mock, at the Central Flying School, R.A.F. Little Rissington, Cheltenham, Glos.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. F. B. King, Gp. Capt. M. C. R. White, C.B.E., Wg. Cdr. H. T. Morgan (with acting rank of Gp. Capt.), Wg. Cdr. P. L. Hancox, O.B.E., Wg. Cdr. A. G. Pell, Wg. Cdr. J. T. Scanlon and Wg. Cdr. A. B. Bishop to the Department of the Air Member for Supply and Organization; Wg. Cdr. B. F. Rixson, O.B.E., D.F.C., A.F.C. (with acting rank of Gp. Capt); Wg. Cdr. D. R. Stubbs, D.S.O., O.B.E., D.F.C., and Wg. Cdr. H. M. H. Tudor, D.F.C., A.F.C., to the Department of the Air Member for Personnel.

Fighter Command: Wg. Cdr. J. W. Allan, D.S.O., D.F.C., A.F.C., to R.A.F. Old Sarum as Gp. Capt. in charge of the Tactical Investigation Section, with acting rank of Gp. Capt.; Wg. Cdr. C. C. F. Cooper, D.F.C., to R.A.F. Wethersfield for liaison duties with the U.S.A.F.

Transport Command: Gp. Capt. D. F. Beardon, A.F.C., to Headquarters as Senior Personnel Staff Officer; Sqn. Ldr. B. F. Stannard, A.F.C., to No. 1 Parachute Training School, Abingdon, to command, with acting rank of Wg. Cdr.

Flying Training Command: Wg. Cdr. W. G. Gardiner, D.F.C., A.F.C., to R.A.F. Hullavington to command the Administrative Wing.

Technical Training Command: Gp. Capt. R. H. Holder to No. 8 School of Technical Training, R.A.F. Weeton, to command; Wg. Off. P. F. Marshall, O.B.E., W.R.A.F., to the W.R.A.F. Depot, Spitalgate, as Senior Training Officer.

EVEN BETTER THAN PROMISED

Before the first Vanguard goes into scheduled service, and little more than a year after the first flight tests, development has made possible dramatic increases in maximum operating weights. Details are given in the table below. These improvements have been achieved for an empty weight increase of only 600 lb, and allow a margin of 1,600 lb for future development, equipment changes or customers' special requirements.

VANGUARD PAYLOAD UP BY 8,000 lb

	Original specification	New specification	Increase
GROSS TAKE-OFF WEIGHT	141,000 lb	146,500 lb	**5,500 lb**
MAX. LANDING WEIGHT	121,000 lb	130,500 lb	**9,500 lb**
MAX. 'ZERO FUEL' WEIGHT	112,500 lb	122,500 lb	**10,000 lb**
MAX. PAYLOAD	29,000 lb	37,000 lb	**8,000 lb**

The Vanguard can now carry 139 economy-class passengers plus over 8,000 lb freight. Without intermediate refuelling, 100-passenger payloads can be carried over such important consecutive sectors as London–Frankfurt–Vienna–Prague.

Operators with profit in mind and air travel for all in view, will find the Vanguard is more attractive than ever.

WINGS DAY SEPT. 17th GIVE FOR THOSE WHO GAVE

VICKERS VANGUARD

FOUR ROLLS-ROYCE TYNE PROPELLER-TURBINE ENGINES

The airliner with the biggest profit potential ever offered to the operator

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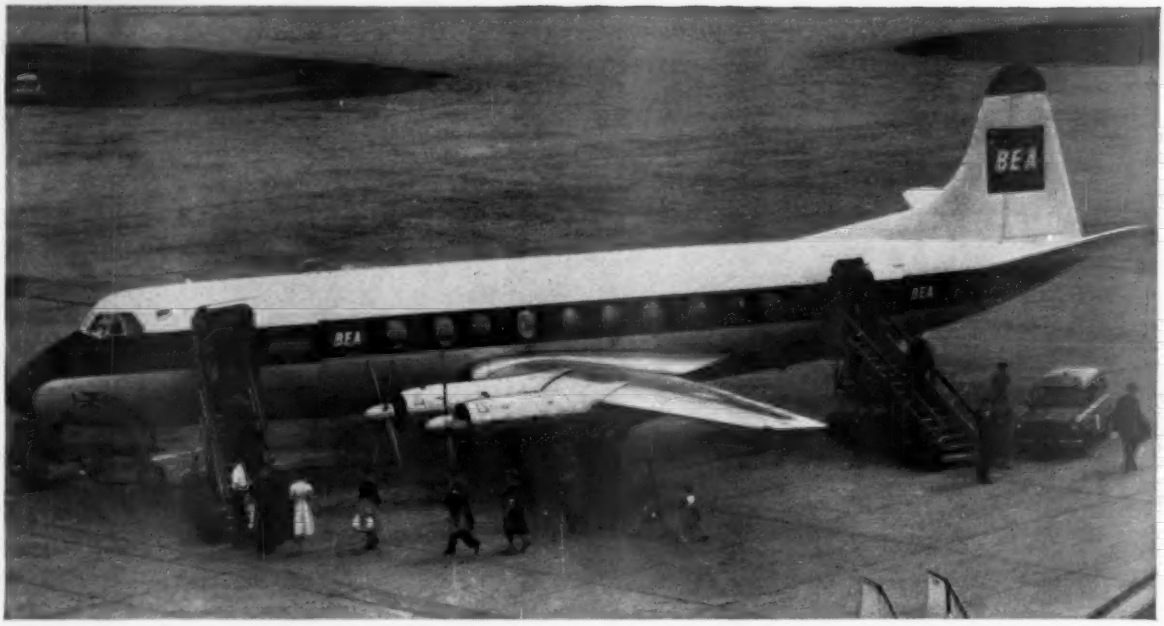
BEA in Britain Today



The quickest, most sought after transport system in Britain

BEA's internal services in the UK now carry more than 1¼ million passengers a year. Each day this summer, between London and Scotland alone, BEA is offering more than one thousand seats, provided by 15 flights from 6 a.m. to 11 p.m. each day.

Compare this with thirteen years ago. A traveller then wanting to fly from (say) London to Glasgow would have found that the lowest fare was £12.10 return, and he had a choice of only 3 services each day. Now passengers have a choice of first and tourist class travel at fares going as low as £8 return for the off-peak services.

Or compare Manchester. Thirteen years ago there were only 2 services a day; now BEA operates no less than 8 services a day between London and Manchester, 2 services a day between Manchester and Birmingham and 2 services a day between Manchester and Glasgow.

HOW BEA HAS DEVELOPED BRITAIN'S INTERNAL SERVICES Thus in the whole UK in 1947 BEA scheduled few internal services. Today in 1960 BEA provides no less than 150 daily services at the height of the season for travel within Britain alone.

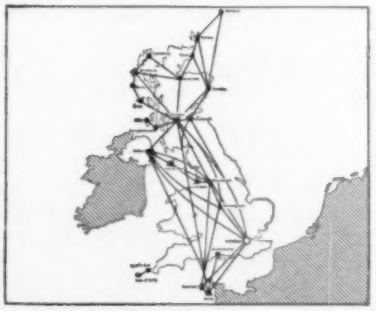
More travellers take to the air BEA has devoted more than thirteen years to the development of air travel within the UK. In the early years of developing BEA's internal services within the United Kingdom, BEA sustained considerable financial losses. Despite this, BEA was convinced that air travel would be welcomed between the principal cities of the country, and these services are now successful and popular. This has been made possible by a vigorous policy of cheaper fares; by the provision of faster and more frequent services; by the introduction of fast modern aircraft; and by the provision of first and tourist class services on the principal trunk routes.

BEA prepares for future growth

BEA has always planned for the future. The first turbo-prop services to be operated anywhere in the world were operated between London and Edinburgh as long ago as 1950. This was the introduction of the now world-famous Viscount. Since that time internal services of BEA have been increasingly operated by Viscount aircraft.

The increasing demand for air travel in the UK led BEA in 1955 to plan with Vickers and Rolls-Royce the powerful 110-seater Vanguard. In 1961 BEA will again be increasing the seats available on its internal services by introducing this large modern aircraft within the UK. BEA will then offer more than 10,000 seats a day between London and the principal regional centres of the country.

In thirteen years of serving the travelling public, BEA has increased its service to the passenger travelling within the UK by no less than five times, and looks forward to providing a better service still in the future.



BRITISH EUROPEAN AIRWAYS

At Sea with the Sixth Fleet—2

By John Fricker

RECOVERY of the large force which, as we described last week, demonstrated a full-scale fire-power demonstration with some 40 aircraft, was uneventful, despite one or two "bolters," or overshoots, when aircraft failed to engage one of the four arrester wires. With the angled deck, and the standard system of retaining almost full power until a positive check is felt, "bolters" present no problem, and it is only the piston-engined Skyraiders that employ a flare-out and power cut when landing on board. Touch-down speed is 90-100 knots for the ADs, compared with 120-145 knots for the jets resulting in a run-out distance after entry into the arrester wires of some 310 ft. down the 670-ft. angled deck. Impact speeds, of course, are reduced by 35 knots from these figures by the deck wind, since above 110 knots, "shear effect," in which an aircraft's arrester hook tends to cut straight through the wires, becomes a limiting factor.

Despite ever-increasing aircraft performances, however, Admiral Needham pointed out that landing speeds had probably reached their peak, and current investigation into low-speed lift augmentation by such means as B.L.C. (boundary layer control) should result in decreased entry velocities. Carrier sizes are equally unlikely to increase beyond the current size of the American giants, and Admiral Needham said that the spectacular new blown-flap McDonnell F4H Phantom II, which has an M=2 performance and is due in service within the next six months, has a slower landing speed than the F8U.

Similarly, the Mach Two North American A2J Vigilante, which is eventually to replace the Douglas A3D, grosses about 56,000 lb., compared with the 72,000 lb. Skywarrior. The latter type makes an imposing spectacle when deck landing, since it is apparently snatched out of the sky to thunder into the steel deck with an awesome impact, until the pilot closes the throttles to take the tension off the run-out wire. As with the other types, except the variable-incidence Crusader, the F3D approaches in a nose-up attitude at a high rate of sink, which is regulated by power as the pilot aligns the "meatball," or blob of reflected light, in the centre of the deck-landing mirror.

On clearing the wires, the aircraft immediately fold their wings (except the A4D Skyhawks, whose 27½-ft. span does not necessitate a fold) and taxi rapidly forward to Fly One, or the bow parking area. There they may be closely marshalled before re-spotting for the next cycle of deck operations, or struck down below in the hangar deck on one of four massive elevators, on both sides, amidships, and aft of the island.

Top Level Briefing

It was a most interesting privilege to attend the twice-yearly Sixth Fleet conference, held at a secret anchorage. There, the newly arrived captains and senior commanders hear a lucid and very frank explanation of the tangled skein of politics in the Mediterranean countries, from their commanding Admiral, and an outline of aims and responsibilities. The fleet must be ready to wage any kind of warfare, hot or cold, limited or general, atomic or conventional, and to reconcile such responsibilities with the primary object of helping to preserve peace demands an extensive knowledge of the political aspects.

The anchorage also provided an opportunity to transfer to other ships, and from the U.S.N.'s newest and largest carrier, we embarked on the oldest in commission, the "Intrepid." First, however, we paid a quick call on the U.S.S. "Canberra," surface-to-air missile cruiser.

Primarily a super-powerful flak ship, the "Canberra" has two stern launching ramps, each accommodating two Convair Terrier BW-0 (Beamrider Wing-zero) missiles. These ramps are automatically fed from large below-deck magazines holding a three-figure number of Terriers in a moving belt-system. With its booster rocket, the Terrier is 27 ft. in length, and 2 ft. in diameter, with a weight of about 3,300 lb. After being launched it accelerates to about 1,500 m.p.h., and is effective within a 10-mile radius and up to about 40,000 ft.

As the U.S.N.'s first operational surface-to-air missile, the Terrier is nearing the end of its useful life, but it has provided valuable operating experience with check-out, launching and directing systems. As a beamrider, its launching rate is governed by the number of fire-control systems and director radars, which can deal with only two targets at a time. Each of two systems stays locked on to one target for a brace of Terriers to climb the radar beam and explode by proximity or "influence" fuse.

A veteran of World War II, the 44,000 ton Essex-class "Intrepid" as she is today.

After each flight of 30 seconds or so the systems are then free to engage new targets, the launchers having been reloaded, as we were shown, in a matter of seconds. The defensive missile perimeter is naturally inside the fleet fighter belt, and the "Canberra" has a heavy conventional dual-purpose gun armament to back up the missile periphery. The ship's extensive radar enables it to duplicate the attack carrier's Combat Information Centre, to take over control of combat air patrols and defensive fighters far away from the CVAs.

With its forward gun armament, the "Canberra" is a "single-ended" missiles cruiser, but the newer conversions will be "double-ended," with guided weapons launchers in the bows, stern and at the sides. All U.S.N. cruisers are to have S.A.M. capability, and will be taken from long-storage for conversion. For the other rôle of the cruiser force, which is shore bombardment and artillery support, the converted ships will eventually receive SSMs, perhaps of the Polaris type.

Improved Terriers, designated BW-1s, are going into the newly converted ships, while U.S. destroyers and frigates are receiving scaled-down versions, named Tartars. Some ships, including the nuclear-powered cruiser "Long Beach," are being equipped with the Bendix Talos long-range atomic S.A.M.

"Canberra" carries its own targets, which are Beech KDB-1 radio-controlled miniature all-metal aircraft, powered by the 120-b.h.p. McCulloch flat-six two-stroke engine. This remarkable unit is turbo-supercharged, and gives the Vee-tailed 600 lb. KDB-1 a maximum speed of 270 knots at 30,000 ft. Its 15 U.S. gal. of fuel gives the drone an endurance of about an hour, after which, if not destroyed, it is recovered by a 40-ft.-diameter reefed parachute stowed in the rear fuselage and released by explosive squibs. Launching is by two 2,500-lb. JATO bottles.

And so to the veteran U.S.S. "Intrepid" (CVA-11)—a survivor of a wartime torpedo and a Kamikaze strike on her wooden overlaid flight deck. Modernized by the latest carrier innovations, the "Fighting I" is a converted Essex-class ship of 43,000 tons, with a current complement of some 70 aircraft.

These comprise Carrier Air Group Six, which is made up of the Sidewinder and cannon-armed Grumman F11F-1 Tiger and Douglas F4D Skyray fighters of VF-33 and VF-74; the A4D Skyhawks of VA-66 and VA-76; the AD-6 Skyraiders of VA-65; and detachments of AD-5Q Skyraiders from VA(AW)-33, F8U-1P Crusaders from VFP-62, and WF-2 Tracers from VAW-12. No twin-jet A3Ds were carried; detachments do operate on occasions, but they are unable to fly with a sufficient margin of safety or operational flexibility continuously from the Essex-class carriers.

As the fleet began to leave its anchorage, "general quarters" was sounded on "Intrepid," and all hands manned their battle stations. This is frequently practised in the Sixth Fleet for instant readiness, and on this occasion necessitated catapulting two fighters from the fleet carriers while they were still in harbour and steaming downwind.

"Flight Quarters" bugle call, relayed throughout the ship, brings a thousand men—a third of the crew—to their stations, and the command "Re-spot the Deck" by Pri-Fly results in blue-shirted aircraft handlers swarming over the closely parked area. Three elevators shuttle aircraft up from the hangars, and while the red-shirted fuelling crewmen unhitch their snaking hoses from wing and fuselage tanks, the *g*-suited pilots in their orange overalls and yellow lifejackets are strapped in by the plane captains.

On a super-carrier, there are 72 fuelling hoses on the flight deck, plus 18 on the hangar deck, and storage capacity is

(*Continued on page 404*)

Right, from the photo section of the U.S.S. "Intrepid" comes this study of one of the ship's F4Ds fitted experimentally with in-flight refuelling equipment. It is topping up from an AD-6 safety tanker, which is diving to maintain the necessary airspeed. Escorting are another F4D and an F8U-1P Crusader.

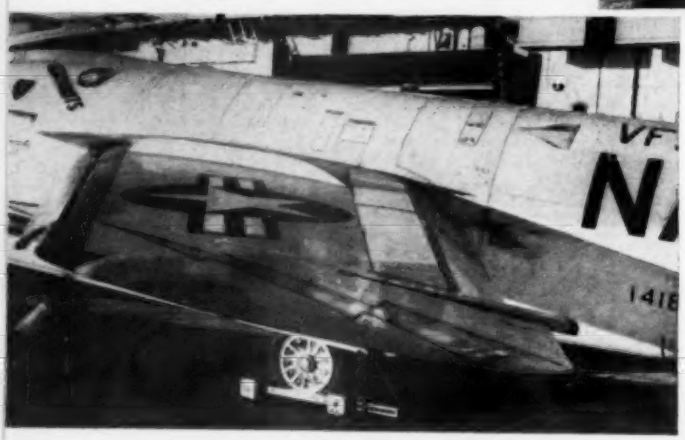
Below, Grumman F11F-1 Tiger supersonic fighters equip Squadron VF-33 on board "Intrepid." They carry four 20-mm. cannon below the intakes, and Sidewinder missiles.

U.S. Aircraft and Missiles

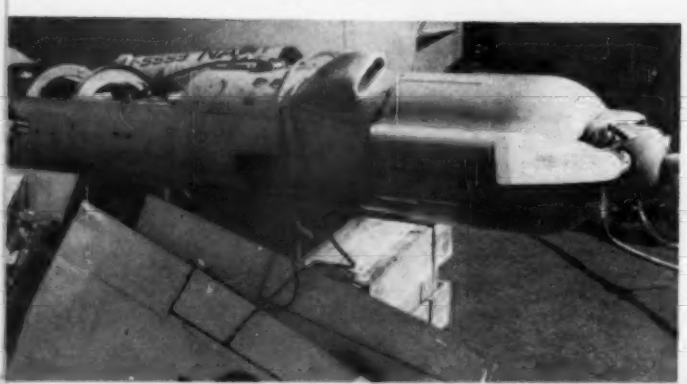
. . . . *A Mediterranean*

Below, for low-speed lift augmentation, the Grumman Tiger has almost full-span slats and flaps, lateral control being by the spoilers visible towards the trailing edge. The wing-tip sections fold for carrier stowage.

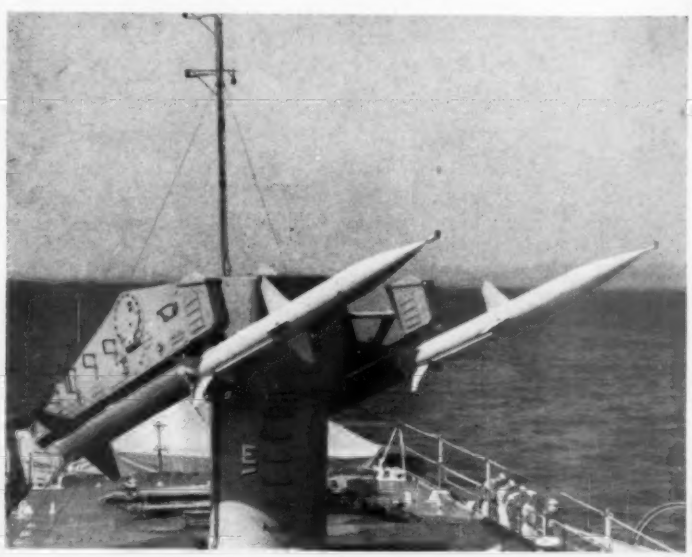
Above, a Terrier beam-rider surface-to-air missile leaves one of the stern launchers of the U.S.S. "Canberra" during trials before this cruise.



Below, this Vee-tailed Beech KDB missile target is stowed on its launching catapult on the "Canberra" for inspection after retrieval by parachute. Note the turbo-supercharger air intake.



Below, the Terrier missiles can be raised on their twin launchers in a matter of seconds from the magazines below deck, and are ready for firing as soon as their target is held by the director radar.



Above, details of radome support and attachment, and empennage modifications are apparent in this photograph of a Grumman WF-1 Tracer on board "Independence." The tailplane is liberally provided with vortex generators.

Miscellany

Above, on "Intrepid's" wooden-planked deck are a Grumman TF-1 Trader, a Douglas AD-6 Skyraider, Douglas A4D Skyhawks, a Chance Vought F8U-1P Crusader and a Grumman F11F-1 Tiger.

Photographs by the author.
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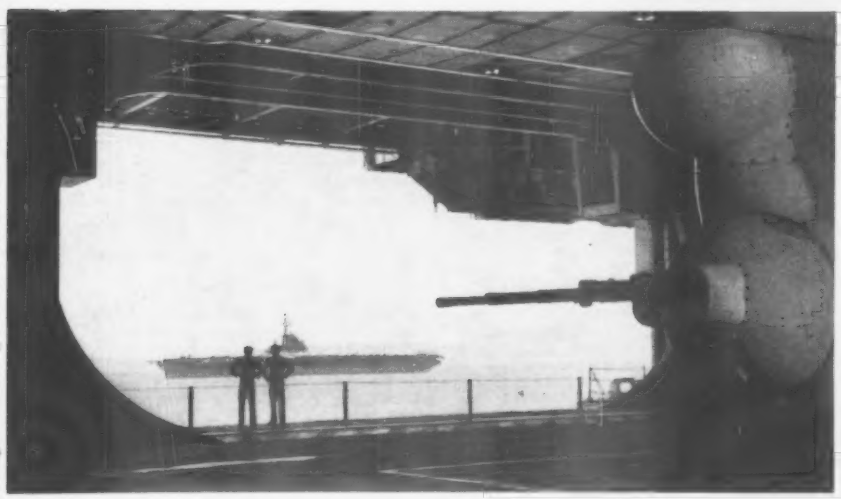
Below, framed by the aperture for the side elevator of the U.S.S. "Independence," and the 20 mm. tail armament of a Douglas A3D Skywarrior is the second Sixth Fleet carrier "Intrepid" at a secret anchorage.



Above, an A4D is centred on the steam catapult on "Intrepid" by a deck handler. The Skyhawk is carrying light practice bombs on its fuselage racks and underwing drop tanks.

Below, the Skyray tailless delta is appropriately named, as its folded wings reveal. The large fillets are hinged as part of the elevon control system. Production of the F4D was completed in 1958 with the 419th aircraft.

Below, for all-weather interception, the single-seat Douglas F4D has APQ-50A radar, coupled with an Aero 13F fire-control system, and the dish scanner is undergoing checks in this photograph.

(Continued from page 401)

provided for 1,279,198 U.S. gal. of JP.5 (HEAF) jet fuel and 110,000 gal. of petrol. "Intrepid" requires slightly less capacity, but still carries a formidable amount of fuel. In quick turn arounds, when the 80-90 minutes cycles between launch and recovery follow in rapid succession, the deck crews have to work with frantic speed to respot, refuel and perhaps rearm the aircraft, while pilots are briefed for the next sortie in their ready rooms.

For the observer, deck operations are interesting enough to watch in daylight, but at night take on an aura of the unbelievable. Great spears of flame are visible from the afterburners of the Tiger and Skyray jets as they strain at full power on the catapults, and they cross the bows in a shower of sparks, as the steel strops release from the accelerator shoe, before they climb away into the darkness.

It is hard to believe that any pilot can enjoy carrier night flying; being shot violently into complete blackness on instruments in a high-speed projectile and having to return to the tiny ill-lit steel heaving deck 100 ft. above the sea with very low fuel margins; to be decelerated from 100 knots to a standstill in 100 yd. This sort of thing goes to prove, perhaps more than anything else, the remarkable adaptability of the human organism to the most alien environment.

It would naturally be impossible to night-fly from carriers without assistance for the pilot in interpreting the aircraft's spatial position and attitude, with reference to the ship and the sea. In addition to his own instruments and navigational aids, he is controlled by the ship's Combat Information Centre, and is under continual radar surveillance throughout his flight. Towards the end of the sortie, the aircraft home overhead on the ship, and are handed over by the Air Controller to CCA (Carrier Controlled Approach) for landing instructions.

With the deck ready for landing, CCA talks the aircraft down from 20,000 ft. at one minute intervals, and brings them into a final approach position in the landing configuration so that they can pick up the mirror lights. At that point, the A.S.I. is discarded as the main speed reference in favour of a simple "fast-slow" indicator which is installed on the coaming of all U.S.N. cockpits in the line of sight for the mirror.

Centring the needle results in the correct approach speed for the particular weight, the instrument working off the angle of attack of the mainplanes. It is also connected to "traffic lights" beneath the nose, which show red for an excessive approach speed, green for correct, and amber for too slow a speed. These lights are interpreted by the L.S.O. (Landing Signals Officer), who is stationed alongside the mirror at all times, and gives a running commentary to the pilot to aid his approach, and provides him with a check on aircraft speeds. The L.S.O. also has SPN-12 radar to give him a continuous indication of aircraft approach speeds.

Despite all these aids, night flying from aircraft carriers will always be an exciting business, as we saw when an A4D of VA-76 flown by the squadron commander, Cdr. Bob Ricks, got below the glide path on the approach to "Intrepid." Full throttle response from the normal 80-85% approach power setting was not forthcoming and with insufficient time to select manual fuel control, an undershoot was inevitable. The pilot took the precaution of arming his rocket assisted ejection seat (RAPEC), which has a maximum trajectory of about 280 ft., and therefore zero height capability down to 70 knots, and had one hand on the face-blind.

The A4D wiped off its mainwheels on the round-down, and skidded along the flight deck on its wing tanks in a great shower of sparks. Fortunately, the arrester hook engaged a wire, and decelerated the A4D, which shed its port wing tank into the deck-landing mirror. The drop tanks were empty, but there were 2,600 lb. of fuel left in the wing tanks, which were punctured by debris, flooding the deck with JP 5.

Crash crews were immediately on the spot to guard against fire, assist the uninjured pilot and move the wreckage, but their most frenzied efforts could not clear the deck in less than 10 minutes. Fortunately, only one other jet was airborne, a Douglas F4D. Skyrays are normally the first to land, but this aircraft had had two wave-offs before the fouled deck caused a third. Its pilot was then down to 1,600 lb. of fuel, and immediately had to consider the possibility of diverting to the "Independence."

His TACAN informed him that the other carrier was 49 miles away, which was too far to divert, so he climbed to 10,000 ft. to conserve fuel. Ironically, the AD emergency tanker was still airborne, but only one F4D has flight refuelling equipment, for testing on this cruise. It was in his squadron, but naturally was not the aircraft he was flying. To add to his troubles, the damaged mirror necessitated a blind approach, assisted only by the L.S.O. "talk-down."

Tension on the flight deck mounted as a call was broadcast for the star-shell projectors to be manned, the normal procedure for night rescue operations. Without her day-flying helicopters as plane-guards, "Intrepid" was dependent on attendant destroyers for search and pick-up.

When the deck was clear, the F4D was down to a meagre 800 lb. of fuel—little more than the absolute minimum for an approach and landing, and the nylon crash barrier was rigged to guarantee an arrival. This took another 2½ minutes, but Lt. Post in the F4D was talked down to an excellent landing; his aircraft engaged the second wire and he entered the barrier so gently that he was unaware of its long nylon strips wrapped round his mainplanes until he opened the cockpit. It was fortunate, but not fortuitous, that he had practised night landings without mirror assistance on an airfield.

Lt. Post had also run through his pre-ejection drill, although the F4D's Douglas seat is less advanced than the A4D's RAPEC unit. It now has a zero delay lanyard for immediate separation after ejection and a minimum safe operating altitude of 200 ft. at any flying speed. Both pilots appeared little the worse for their harrowing experiences, but one got the impression that the occasion was such as to make the total prohibition on liquor aboard U.S.N. ships all the more regrettable. The competent handling of a potentially hazardous situation provided a yardstick of Sixth Fleet efficiency.

To complete this story, some notes on Sixth Fleet aircraft are appended:—

Douglas A3D-2 Skywarrior (two 12,000 lb.s.t. Pratt & Whitney J57-P-10 turbojets).—Main U.S.N. nuclear bomber; also carries 12,000-lb. explosive bombs. Capable of L.A.B.S. bombing with automatic, semi-automatic or manual techniques. Crew of three, pilot, bombardier/navigator and flight engineer/radioman/gunner; no ejection seats. One heavy attack squadron on each carrier, with up to 18 aircraft. Full all-weather attack capability, and can lead A4Ds in non-contact conditions as "two extra bomb-racks." Extra responsibility then involved for bombardier/navigators to memorize additional targets. Defensive armament of two 20-mm. tail cannon, removed on "Independence" because of corrosion. Typical mission, 5½ hr. Has flight-refuelling equipment.

Douglas A4D-2 Skyhawk (one 7,700-lb. Wright J65-W-16A turbojet).—Lightweight single-seat attack aircraft, known to its crews as the "Tinfoil Terror." Fixed armament of two 20-mm. Colt cannon. Infinite variety of tactical weapons, including nuclear type, on 3,000-lb. fuselage and 1,000-lb. (each) wing racks. F.R. equipped and carries buddy tank for tanker duties. Max. weight about 21,000 lb., dry weight, 9,600 lb. Range, 1,200 miles.

Douglas F4D-1 Skyray (one 10,500-lb.s.t. Pratt & Whitney J57-P-8 turbojet developing 14,500 lb. with afterburning).—Tailless delta all-weather fighter, with radar navigation and Aero 13F fire-control systems. Four 20-mm. cannon in wings and wide range of underwing stores, or two 300-U.S. gal. drop tanks. One aircraft with special probe-equipped drop-tank for F.R. Control via split elevons (including inboard fillets) on wing trailing-edge with variable gearing; auto-slats on leading-edge. Loaded weight, 21,000 lb.; max. speed, M=1.05 at 36,000 ft. VF-174 to be first McDonnell F4H squadron.

Chance Vought F8U-1P and -2 Crusader (one Pratt & Whitney J57-P-4A or -P-16 turbojet, developing 16,200 or 16,900 lb. thrust for take-off with afterburning).—Single-seat tactical recce. and all-weather fighter, versions respectively. Former unarmed, carries three trimetrogen and two vertical cameras in area-ruled forward fuselage; F8U-2 carries four 20-mm. cannon and two Sidewinder AAMs, plus belly pack of 32 2.75-in. rockets. Variable incidence wing and drooping leading-edges. F.R. equipment. Max. weight, 27,000 lb. Undercarriage stressed to 20.5 ft./sec.; 138 knot 4 degree approach gives 12 ft./sec. landing in 35-knot deck wind.

McDonnell F3H-2 Demon (one 9,500-lb. Allison J71-A-2 developing 14,250 lb.s.t. with afterburner).—Single-seat all-weather fighter carring four 20-mm. cannon and external stores, including Sparrow III radar-homing missiles. Unlike Sidewinder fighters, which are restricted to attacks in stern quarter of jet-pipe temperature area, Sparrow-Demons can make interceptions at any angle, including head-on. F.R. equipped, and gross weight of 33,000 lb.

Grumman F11F-1 Tiger (one 7,800-lb. Wright J65-W-18 turbojet developing 10,500 lb. with afterburning).—Single-seat fighter armed with four 20-mm. cannon and underwing Sidewinder AAMs, or offensive stores. Leading-edge slats and full-span trailing-edge flaps; lateral control by spoilers. Gross weight, 23,850 lb. F.R. equipped. Scheduled for replacement by later Crusaders.

Douglas AD-5Q and AD-6 Skyraider (one 2,700-b.h.p. Wright R-3350-26WA radial engine).—Multi-seat general-purpose and single-seat close support aircraft, respectively. Nuclear capability, including L.A.B.S. delivery, but conventional rôle more important, for limited Wars. Can carry every type of aerial ordnance now in service; fixed armament, two 20-mm. cannon in each wing. Max. external load, 10,500 lb. Max. endurance, 13 hr., if oil supply lasts. In tanker rôle during deck operations carries 300 U.S. gal. buddy pack and flies at M.E.T.O. power at 10,000 ft.; orbit station is at 2,500 ft. ahead of ship. Max. weight, 25,000 lb.

Grumman WF-2 Tracer and TF-1 Trader (two 1,525-b.h.p. Wright R-1820-82 radial engines).—Carrying the largest radar scanner yet fitted to an aircraft, the WF-2 "flying saucer" was developed from the TF shipborne transport. Main differences are its extended front and rear fuselages and twin fin and rudder tailplane to accommodate the enormous radome. Tailplane is liberally provided with vortex generators to stabilize airflow over elevators. Wings fold aft instead of upwards, as in TF-1 and original S2F Tracker. Crew of four includes two radar operators, and second pilot becomes tactical director during A.E.W. and fighter control operations.

Super-carriers in service with the U.S.N. comprise the CVA 59 "Forrestal," CVA 60 "Saratoga," CVA 61 "Ranger," and CVA 62 "Independence," while awaiting completion are CVA 63 "Kitty Hawk" and CVA 64 "Constellation."

Spot not on the map

You are unlikely to find Jiwani in your atlas. A small fishing village, it lies in rugged, waterless country on the coast of West Pakistan, 40 miles from the Iranian border and 350 air miles from Karachi. Roads are mere sand tracks and the only approach is by sea or air.

Air? Yes, Jiwani has an airfield. True, today's airliners seldom use it, except in emergency; but to smaller aircraft of limited range flying through to the Far East it is an essential staging point.

Life at the base is lonely and spartan. Water is rationed and food is sparse. Communications are poor. There is an irregular coastal launch service from Karachi and once a month a Dakota of Pakistan International Airlines flies in supplies and relief staff. Mail comes via Gwadur 65 miles away by runner or camel. How welcome are the visitors who land to fuel!

To keep Jiwani supplied with aviation fuel is far from easy. But Burmah-Shell takes care of that. Supplies are shipped from Karachi in "country craft" which are run aground at high tide and the drums off-loaded by plank ramps to the shore. The trip takes 8-10 days, but for 4 months the monsoon makes sailing well nigh impossible.

Shell aviation service operates in all kinds of places throughout the world, no matter how difficult they may be to supply . . . at famous international airports and at little-known airfields which, like Jiwani, serve Aviation in remote parts.

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Speeches at the S.B.A.C. Dinner

ALTHOUGH Farnborough Week is no longer opened by the S.B.A.C. dinner, which now takes place on the Wednesday, the fact that the Minister is the guest of honour and may be expected to speak about Government policy before so many distinguished visitors gives the latter occasion a particular significance.

This year the new Minister of Aviation, Mr. Peter Thorneycroft, introducing himself as gamekeeper turned poacher (once guardian of the public purse, he is now head of a great spending department), assured the Aircraft Industry of continued Government support. He recognized that what the Ministry of Aviation does will remain, and rightly remain, expensive. It must be ridded of the label of being extravagant.

Development and research must certainly go on. Object of the Government is not to take the risk out of manufacturing aircraft, which would indeed be a difficult task, but to show a willingness in certain fields to share it. Such support is not a form of Government charity, but a reinforcement of success.

Much is said today about national prestige. But a man or a nation who starts thinking and worrying about his individual prestige is in some danger of losing it. Prestige is certainly not earned by living beyond one's resources, but by courage, good sense and a certain generosity in sharing the fruits of one's ideas.

These are not arguments for inactivity. They are arguments for prudent action and for laying down priorities.

For the United Kingdom alone to seek to compete in the field of manned space vehicles with Russia and the United States would certainly be imprudent and probably impossible. There are, however, spheres of space research, commercial, technical and scientific, which fall far short of this. If such research and development, whether in the field of satellites or launchers, is to be carried on outside the United States and Russia, let us at least make an effort in the Commonwealth and in Europe to find a co-operative basis for it. If we are to look towards the stars let us look a little beyond our own national frontiers first of all.

There is apparently a limited market for supersonic commercial aircraft. There is, in this supersonic field, a powerful case for all of us agreeing what to make, when to make it and then making it together. Our studies of a supersonic civil aircraft are indeed well advanced and will soon be advanced still further. We are very ready to consider how we might collaborate with the Americans, the French, or other overseas friends who are interested.

In the field of airline operation in all its forms, we should seek particularly in Europe, by all means, ways of assuring an even closer association. That goes for airline operation, for manufacture, and for forms of traffic control such as Eurocontrol.

Do not let us forget that, faced with the choice of travelling at four times the speed or a quarter the price, there may be some earth-bound citizens today who would choose the latter. There are many exciting fields of advance in aviation. They are not all in the stratosphere or at supersonic speeds. Quite a lot of them are slower and closer to the earth.

The first speech of the evening was made by Sir George Dowty, president of the S.B.A.C. He began by saying that the main purpose of Farnborough Week is to stimulate export business. The S.B.A.C. Display and Exhibition, the most important event in Britain's aeronautical calendar, attracted over 300,000 visitors last year showing that this annual event is losing nothing of its appeal. Apart from its value as a shop window for the industry, it enables the Society to contribute many thousands of pounds each year to the charities of the fighting services.

This year's exhibition, the biggest in the history of the Society, forms, without doubt, the largest display of aeronautical products ever seen under one roof anywhere in the world.

Over the past 15 years, exports have reached the huge total of £1,000 million and last year they were an all-time record—£156 million—and this represents earnings of some £3 per head of the population, a figure unmatched by any other country.

It is a great credit to the engine manufacturers that of all turbine-powered airliners operating in the western world nearly two-thirds have British powerplants. Companies developing and manufacturing specialized equipment export their products even more widely than their colleagues manufacturing airframes and engines.

During the first eight months of this year, orders have been received for 97 transports worth £100 million. The export orders are for Comets, Viscounts, Argosies, Vanguards, Avro 748s and Britannics and home orders have been for the Super VC10, the Comet, the Argosy, the Herald and the Britannic Freighter.

A Question of Prestige

The launching of Russian satellites has given the Soviet Union world prestige. The pioneering of a supersonic transport to go half-way round the world in six hours will also have great prestige value and it can have a decisive effect on world leadership in aviation. We all know that subsonic aircraft will provide the most important markets for many a long year, yet the development of a supersonic transport will bring great technical advances and will help us to maintain our position in the aeronautical world.

So far we have scratched only the surface of air freighting of cargo, a field where great opportunities lie. In spite of the recent expansion in this business, it is interesting to note that only 5% of our country's total exports are currently being air-freighted. There must be extensive markets in those less developed countries where conventional transport systems do not exist and where perhaps they never will. We should, therefore, look to the development of these vast areas of the earth whose crops and minerals cannot as yet reach the world's markets.

One feature that can make this form of transport even more interesting is that of vertical take-off and landing, eliminating runways that are both costly to build and maintain. As well as vertical take-off machines, there are many well-developed helicopters to be seen on show. With the amalgamation of our resources for the production of rotary-wing aircraft, this country now has the largest single manufacturing group for helicopters anywhere in the world.

We hear on all sides the need for international co-operation and one important matter that concerns us all is that of noise, a cause of great annoyance to the public in every country. The Society of British Aircraft Constructors with the Royal Aeronautical Society has set up a joint expert committee to advise on this difficult matter.

The time required to develop and put into production any major aeroplane or its engine can take from six to seven years at least. It follows, therefore, that the British Aircraft Industry should have a 10-year plan covering its minimum "musts" together, of course, with an adequate research programme.

Final Farnborough Report . . . .

Aircraft News from the Exhibition Tent

JUST as the Short SC.1 became the star of last week's S.B.A.C. display at Farnborough, so also were VTOL applications among the more interesting of the indoor displays by the aircraft and engine companies. As a result of the re-grouping and merging within the industry, the static show was arranged this year around the central displays of the "big five"—B.A.C., Hawker Siddeley, Westland, R.-R. and Bristol Siddeley. But it was two of the smaller stands outside the central group—those of Short Bros. and Harland and Boulton Paul Aircraft—that had most to show in the way of VTOL projects.

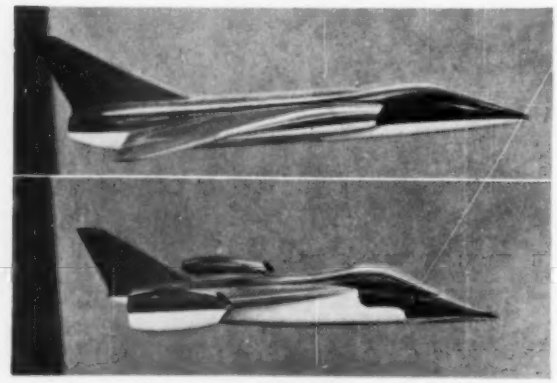
The SC.1 itself has now served its purpose of demonstrating the complete feasibility of the jet-lift concept, and while there is an M.o.A. research contract to cover further flight testing, Shorts are undoubtedly very disappointed at the lack of official follow-up. In the past five years or so, at least 20 detailed proposals have been submitted by the company to the Ministry for various types of military VTOL aircraft, and two such were shown as models on the stand last week.

One of these, the PD49, is designed to meet a current requirement and cannot therefore be described in detail. A light strike aircraft, it has one propulsion engine and six lift engines in the fuselage, making use of the newest Rolls-Royce units. The other model for a similar class of aircraft, has two lift engines in the fuselage and a pair at each wing tip in tilting nacelles for both lift and thrust. Objections that military aircraft of this type cannot operate VTOL from unsurfaced fields (because of the debris and dust problems) are countered by the argument that a suitable take-off platform can be carried on a single truck, which would be simply added to the train of vehicles required for fuel, armament, etc., for any rough field operation.

Shorts also showed a Griffith-type slender delta airliner, of the kind displayed in sectioned form by Rolls-Royce and illustrated in our previous issue. Among some interesting historical background to the Griffith work shown by Rolls-Royce was a pilotless tail-sitter fighter project of 1945 with a delta wing.

Boulton Paul did little more than lift a corner of the curtain which until recently has shrouded this company's work in the VTOL field, to give a tantalizing glimpse of some of the results. Under Ministry contracts which go back four years or more, B.P.A. have been investigating possible VTOL configurations, and two wind-tunnel models were exhibited. The first had a delta wing and four thrust engines paired in two nacelles under the wing. Only a single lifting fan was shown in this forward part of the wing, but another similar layout with three such fans has been tested in the Duplex Tunnel at the N.P.L.

The second wind-tunnel model was designed to study flow interference through the use of multiple fan layouts in the wing, and consisted of a rectangular wing in which two, three or four fans could be located in spanwise or chordwise rows or staggered patterns. This model was tested in the 13 ft. by 9 ft. tunnel at the R.A.E., Bedford.



Two applications of VTOL to light strike aircraft designs by Short Brothers. The PD49 (top) has six lift and one thrust engines. The other project has two lift and four lift-and-thrust engines, the latter in tilting wing-tip nacelles.

Ducted-fan Lift Units

The use of lift fans, moving larger masses of air more slowly, is regarded by Boulton Paul as a logical extension of the Rolls-Royce/Griffith work on lift engines. The fan can be powered in various ways—by hot exhaust gases, with or without intermediate afterburning, or by compressor bled air ducted to turbine blades integral with the fan blades; or by shaft drive from a separate turbine powered in turn by air or gas from the thrust engine. Studies of all these types have been made by Boulton Paul.

The third B.P.A. model showed a private-venture design, the P.146, for a short-haul VTOL airliner carrying 96 passengers with five-abreast seating. A canard layout has been adopted, lending itself to the location of banks of direct lift engines at the tips of the wings (four engines in each bank) and nose-plane (five engines). This arrangement allows adequate control without recourse to compressor bled air and "puff-pipes" as used on the SC.1. The aircraft is designed to cruise at 400 knots on three rear-mounted turbofans.

The lift units are lightweight ducted fans of unspecified type and power, but assuming the project weighs about 120,000 lb. and allowing a thrust-weight ratio of 1.15 to 1, these engines might be expected to develop a total thrust of about 135,000 lb. or 7,500 lb. each. Accepting the Rolls-Royce claim that the newest lift engines have a power-to-weight ratio of 16 to 1, the engine weight might then be about 470 lb., or 8,440 lb. in all (plus the pods). According to Boulton Paul studies, there is no lighter way to obtain VTOL performance in an aircraft of this kind than by separate lift and thrust engines.

Using the S.B.A.C. method, direct operating costs for the P.146 have been worked out at 2¼d./passenger mile over 200-500 nautical-mile stages assuming 2,000 hr. annual utilization, or 2d. a mile for 3,000 hr. utilization. For 500-1,000 nautical-mile stages, and using the engines to give a short take-off and vertical landing, costs would be 1¼d. and 1½d. respectively for these two utilizations.

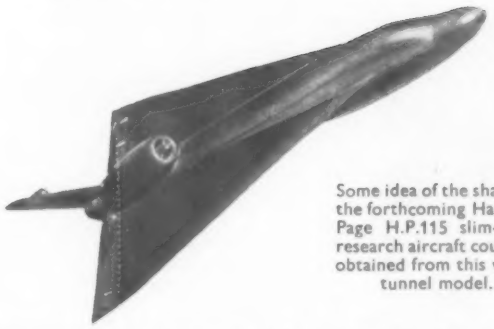
In contrast to these lightweight lift engines, Bristol Siddeley displayed their combined lift/thrust BS53, together with an artist's impression of a typical application. The fact that the illustration was removed soon after the show opened led to some speculation on its possible similarity to the forthcoming P.1127, which the BS53 powers.

Also (just) in the VTOL bracket are ground effect machines, of which the only example at Farnborough this year was the SR.N2, represented in model form on the Westland stand. Powered by four Blackburn Nimbus free turbines, this 27-ton, 66-passenger prototype will have two large fans of 12.5 ft. diameter each and a total cushion area of 810 sq. ft. It will be 63 ft. long and have two pusher propellers. Maximum hover height at light weight will be 2.5 ft.

Supersonics

The Griffith narrow delta design is an example of a possible supersonic shape of the future. Some more pointers to this shape were seen on the Handley Page stand, where there was a wind-tunnel model of a small narrow delta similar in most respects to the Viper-engined H.P.115 research aircraft expected to fly about the end of this year.

The same theme was used for a model of a 139-ton trans-atlantic Mach 2.2 airliner project, used by Handley Page to



Some idea of the shape of the forthcoming Handley Page H.P.115 slim-delta research aircraft could be obtained from this wind-tunnel model.

demonstrate the advantages of laminarization. For a given range, this project has 50% higher payload and 39% lower costs if it is laminarized. For a given payload, the range advantage is 29% and costs come down by 21%.

The big subsonic H.P.117 laminar-flow project, also featured on the stand, was illustrated in our previous issue.

Virtually nothing could be learnt at Farnborough—at least for public use—on the supersonic transport projects of the two big groups beyond the fact that Hawker Siddeley have submitted design studies to the Ministry for Mach 2.2 and Mach 2.7 aircraft, and the principal B.A.C. proposal is for Mach 2.2. The most tangible evidence of advanced supersonic research in this country was, therefore, to be found in the Bristol corner of the B.A.C. stand, where the Bristol 188 was featured. In an accompanying Press release, the design of the 188 was summed up as follows:—

"The general aircraft configuration is a fairly complicated arrangement of carefully shaped wings, body and nacelles dictated by the various research rôles which the aircraft will be called upon to fill. The thin wing, which has a span of 35 ft. 1 in. and an area of 396 sq. ft., is of constant chord between the body and the nacelles, but outboard of the nacelles the leading-edge is swept back at an angle of 38 degrees and the tip of the wing, formed by the balance area of the aileron forward of its hinge, has a leading-edge sweep-back angle of 64 degrees.

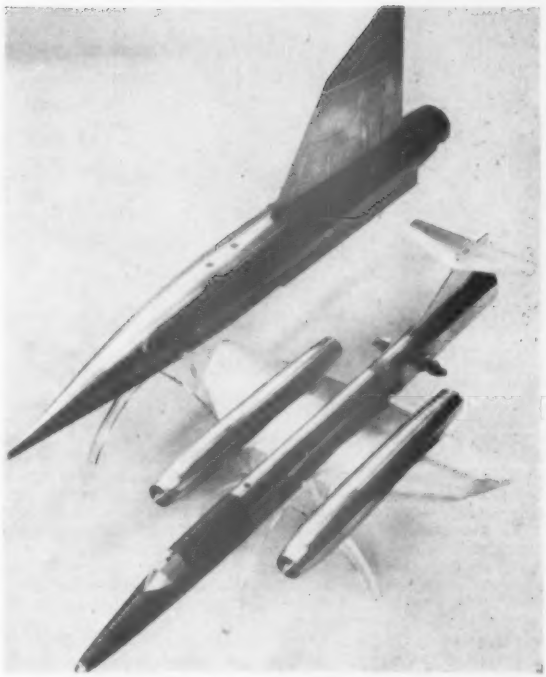
"The fuselage, with an overall length of 71 ft., a maximum width of 3 ft. 9 in., and a maximum depth of 4 ft. 11½ in., is oval in cross-section. The maximum section of the body was determined by that required to accommodate the pilot and his seat. There is a small amount of waisting which, with the location of the separate engine nacelles, gives a favourable distribution of areas for supersonic flight. The tailplane is mounted on top of the swept-back fin, clear of the jet efflux from the engines. The engines which will initially power the Type 188 are two de Havilland Gyron Junior DGJ.10 reheated turbojets.

"One of the many lines of investigation which can be undertaken with the Type 188 is research into engine air intake design . . . and developments are already in hand which will explore the performance of intake shapes matched to the existing engines but representative of trends in design for supersonic projects.

Now under construction by Saro, the Westland SR.N2 Hovercraft is powered by two Blackburn Nimbus turbines.

"The Type 188 will be flown by the chief test pilot of Bristol Aircraft, Ltd., Mr. Godfrey Auty. The first take-off [probably early next year—ED.] will be made from Filton, and the test programme will then be continued at the A. and A.E.E., Boscombe Down. The first phase of the flight programme will consist of familiarization flying. Once the basic flying qualities and handling characteristics of the aircraft have been proven, flight speeds will be advanced by progressive stages, from low speeds to transonic and, ultimately, supersonic speeds."

In addition to a 1/10 scale model, Bristol exhibited a full-size specimen of the 188's all-moving tailplane and two wind-tunnel models—a ¼ half-wing for measurement of aileron hinge moments and a 1/36 scale model for stability measurements in the 3-ft. by 3-ft. tunnel at the R.A.E. The tailplane exhibited showed construction which is typical of all the control surfaces.



Two wind-tunnel models of the Bristol 188 were on the BAC stand. The complete model is interesting in showing the shape and location of the cascade-type rear-fuselage air-brakes.

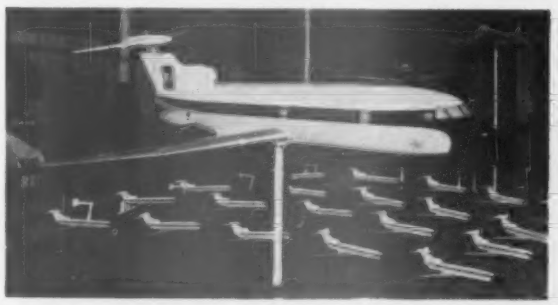
Most joints are made by "puddle-welding" (fusion welding in an inert atmosphere) with some joints made by high tensile steel bolts or Jo-bolts. The wing skins are taper ground and range from 0.04 in. mean thickness at the outboard ends to 0.10 in. mean at the centre-section.

Subsonic Transports

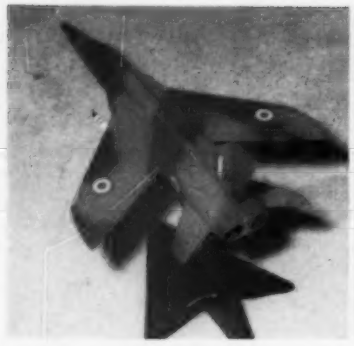
The trend towards rear-engined layouts was a marked feature of the commercial aircraft projects displayed, of which the newest were the baby-jet twins, BAC-107 and Avro 771, and the newest developments of the VC10 family including the Super VC10 Jetfreighter. All these were thoroughly described in our first report from Farnborough last week.

Neither of the two groups has yet taken a decision to proceed with the baby jet, but market surveys show a promising degree of interest, and B.A.C. are talking in terms of a first flight for the 107 by the spring of 1963 if construction is allowed to proceed. This project will, incidentally, be an interesting example of the practical benefits of merging. An original Hunting design concept, it now incorporates the lessons of Vickers' invaluable commercial aircraft design and sales experience and will be produced in the Bristol Aircraft factory at Filton, where space is most readily available.

Making up for the unfurnished interior of the Avro 748 in the flying display was the full-size front-fuselage specimen on the stand, this year in Aden Airways colour. Other models showed this aircraft in the markings of Skyways, B.K.S. (whose order was increased from two to five last week) and the Indian



In addition to a large-scale model of the Trident, de Havilland showed the entire B.E.A. fleet of 24 in 1/72nd. scale models.



Left, two new versions of the Folland Gnat — a twin-engined supersonic fighter and an all-through trainer with a new wing and tailplane.

Below, this model of a developed version of the Victor—with larger engines and intake ducts—was shown by Handley Page carrying four "Skybolt-type" ALBMs.

Air Force; while a larger, sectioned, model showed a possible executive interior.

Handley Page—which company must be given credit for a particularly interesting and informative stand—was able to announce the first firm Herald sale last Tuesday. Jersey Airlines is buying six of the slightly lengthened version, which has a 42-in. extension in the fuselage ahead of the wing. This allows the seating to go up to a maximum of 56, or 50 with normal toilet and galley allowances.

The gross weight may be 40,000 lb., for which the Herald has already been cleared at temperatures up to ISA+13° C. Modifications are being designed to allow the landing weight to go up to 39,500 lb. Deliveries to Jersey are to begin next June, after three of the shorter-fuselage models have gone to B.E.A.

In model form, Handley Page showed the HPR.8, the short-range car ferry and bulk freighter developed from the Herald as a replacement for the Bristol 170s used by Silver City Airways. Further work on this awaits an airline order.

A working model on the Hawker Siddeley stand showing the Rolamat system in use loading an Argosy was excellently arranged to demonstrate the simplicity of this system, and the B.E.A. markings were a reminder that the Corporation is expected to lease three of the first 10 Argosies. The remaining seven are to go to Riddle Airlines. The latest R.A.F. order, for 16, was one of three orders for transport aircraft announced by Hawker Siddeley during the week. Another, for Avro 748s, has been mentioned above, while the third, for five Comet 4Cs for the R.A.F., allowed de Havillands to claim that the Comet 4 had now broken even (but not, presumably, if the Comet 1 development costs are included).

Helicopters

Thanks to the merging of all British helicopter interests into one company, Westland now offers a larger rotary-wing range than any other company in the World. This range was represented in model form on the stand.

Taking them in order of weight, largest first, the Rotodyne now seems set with an Army order for 12 imminent, probably with Napier Elands, and the B.E.A. specification nearly finalized. Development of the private venture Westminster, on the other hand, is about to be suspended unless or until firm military or civil orders can be obtained. In the most recent phase of trials, with a Sikorsky six-blade rotor, investigations of the blade stalling problem have suggested that useful increases in speed could be made over the figures previously announced.

A development of Bristol's work is the Westland 194 project, a tandem-rotor 50-seater with four Gazelles. Like the Westminster and the twin-Gazelle Wiltshire based on the Sikorsky S-61, the 194 will be available for development if required. A more immediate civil prospect is the Westland 192C, which may be adopted by B.E.A. for interim use until the Rotodyne is ready.

Production deliveries of the Belvedere itself to the R.A.F. have now begun and the first squadron is forming at Odiham. New features on the production Belvederes are a sliding (in place of upward-hinged) main door, metal rotor blades; power controls; larger-diameter lower-pressure tyres, and a finalized tailplane arrangement which has compound anhedral. An intermediate version with single anhedral was seen on the Belvedere in the flying display at Farnborough.

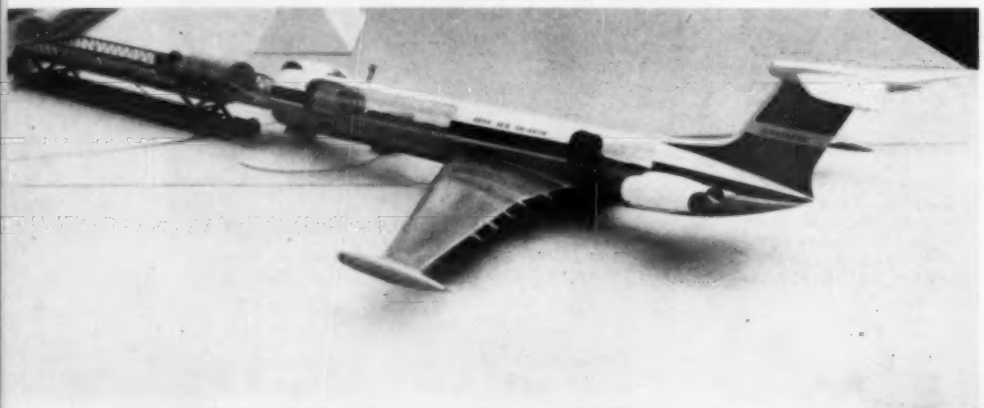
Another promising civil helicopter is the Twin Gnome Wessex or Wessex 2, which is the subject of an M.o.A. development contract and is to fly next year. The Coupled Gnome power-plant of the Wessex 2 comprises two Gnome H.1200 engines driving into a common gearbox and giving 2,500 s.h.p. take-off power. As the Wessex 2 transmission will be the same as that of the Gazelle-engined Wessex 1, the engine will be "gated" to give a maximum of 1,500 s.h.p., the excess power being available for improved hot weather and high-altitude performance.

The Whirlwind 10, as the Gnome-Whirlwind is now known in its R.A.F. form, is to be produced at Yeovil, and once deliveries are under way, the R.A.F.'s older Whirlwind 2s and 4s will be returned for conversion. Two Gnome-Whirlwinds are now flying; the first originally flew with an American T58 in February 1959 and then with a D.H. Gnome last September. The second Gnome-Whirlwind flew in June this year.

A further order for Sprites for the Army was announced by Westland last week, consolidating the position of this little helicopter, originally developed as a Saunders-Roe private venture.

Trainers

As briefly noted last week, the Hawker Hunter T66A—represented by a large model in the exhibition tent—arrived at Farnborough carrying two enormous 350-gal. tanks. Developed as a private venture, these tanks are similar to the 250-gal. variety with additional centre bays. Two 100-gal. tanks also can be carried under the Hunter's wing for a remarkable underwing total of 900 Imp. gal. Other new items on G-APUX since it appeared last year are windscreen wipers,



The Vickers VC10 Jetfreighter, announced at Farnborough and described in our previous issue, has a swing-nose and was shown in this layout with the proposed freight loading jetty.

an ADF aerial behind the cockpit and DME aerials in each intake duct.

On the B.A.C. stand, Hunting showed a Jet Provost procedures trainer, as now used by the R.A.F. This is a full-scale representation of the Jet Provost cockpit in which pupils can learn all their routine and emergency drills.

Details of the Jet Provost T.4—now ordered by the R.A.F. in an undisclosed quantity—showed that this version, with Viper 200 (ASV.11) can be used with a "gated" throttle at Viper 102 (ASV.8) thrust for all primary pilot training, at better economy than the Provost 3. It can then extend the training syllabus, particularly in terms of rate of climb and altitude, when full advantage is taken of the power of the larger Viper.

Of the 14 Folland Gnat trainers ordered by the M.o.A. for evaluation, nearly half have now flown. The first eight are to be used for airframe and systems development in general, while the final six, to full production standard, will be delivered next year to the C.F.S. for handling trials. Two models illustrated possible future development for the Gnat trainer, including an armed version carrying either RPs or bombs under the wings, or an Aden gun in an external pod (with ammunition) each side of the front fuselage.

For small air forces, Folland has proposed the Gnat as an "all-through" trainer, onto which students could graduate after 20 hours or so on a piston-engined primary of the Chipmunk type. This "all-through" Gnat has the existing fuselage, but a new straight wing with larger flaps, and larger tailplane, to reduce the landing speed by about 20 knots.

A more advanced development, the Gnat 5, is based on a wing of the same dimensions as the Gnat trainer, but having a thinner (4-5%) section. This wing would have more high-lift devices—drooped leading-edge or, perhaps, a blown leading-edge—and two small-diameter engines would be used side by side in the rear fuselage, with reheat. The Rolls-Royce RB.153 and advanced Bristol Siddeley Viper were mentioned as possible powerplants.

Armament for the Gnat 5 would comprise two Firestreak, Sidewinder or other AAMs on the fuselage nose, and the aircraft would have a speed of Mach 2 and a 60,000-ft. ceiling. Either single or two-seat versions could be produced, the latter being, like the Hunter 7, a dual-purpose aircraft for full operational use or advanced training.

Military and Naval

The most important British aeroplane *not* at Farnborough and probably the most advanced aeroplane of its class under development anywhere in the World is the B.A.C. TSR2, the supersonic tactical strike and reconnaissance aircraft for the R.A.F. A joint English Electric/Vickers project, the TSR2 weapons system is described as having "airborne flexibility and wide diversity of use . . . for operation in all parts of the World, capable of using short and low-grade airfields."

It is understood to have a Mach 2+ performance and will be powered by two developed Bristol Siddeley Olympus engines of more than 30,000-lb. thrust with reheat. On the Monday of Farnborough week, a presentation on the TSR2 was held at Weybridge for the U.S. Asst. Sec. of Defense and a U.S.A.F. delegation.

Much nearer completion than the TSR2—and expected to fly before the end of this year—is the Hawker P.1127, another of the important aircraft about which nothing could be said officially at Farnborough. In its absence, the newest military aircraft on show were the Lightning and the Buccaneer.

Optional armament and equipment for the English Electric Lightning were arranged in the static aircraft park—including Ferranti Airpass 1, Aden guns, and Microcell rocket packs.

Of the English Electric Lightning, the makers said last week that "the past year [of] final development flying . . . has clearly shown that the Lightning is one of the most potent and versatile fighters anywhere in the World. It has flown at more than Mach 2 and showed how effective is its combination of 30-mm. cannon and two de Havilland Firestreak homing missiles, or 2-in. Microcell rockets, and how unerringly its Ferranti Airpass radar leads it to its target."

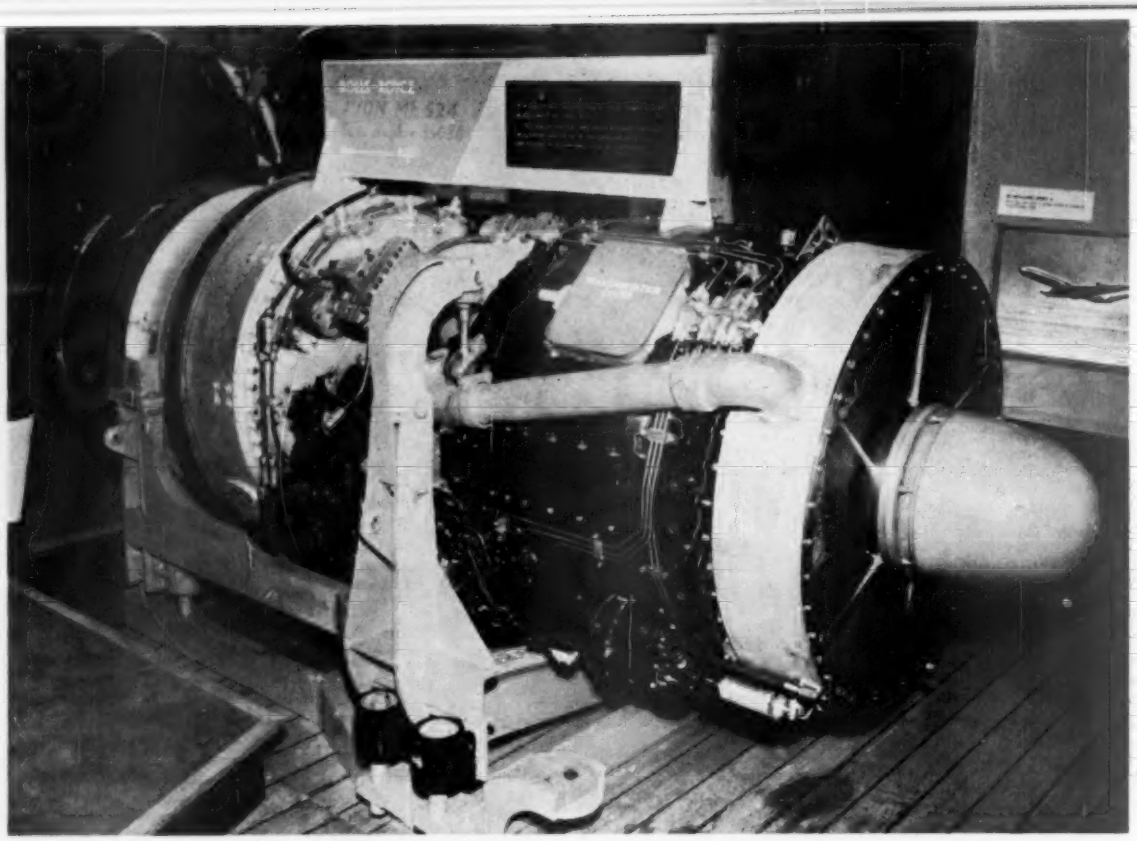
Nine Blackburn Buccaneers of the development batch of 20 have now been flown. The whole of the batch should be flying by next year, when the final six will be used for initial service trials by the Handling Squadron.

As we noted briefly last week, several differences were visible between the two examples (Nos. 3 and 4) at Farnborough, and further changes have been made on later aircraft. In particular, an additional slot has been introduced under the wing leading-edge so that the super-circulation system can be used also for de-icing. A section of Buccaneer wing on the Hawker Siddeley stand showed the machined skin construction, with four main spanwise panels comprising the top and bottom surfaces.

Both the Vulcan 2 and Victor 2 models were shown with Blue Steel stand-off bombs, which in due course will become the standard V-bomber armament. Neither the Vulcan 2 nor Victor 2 development aircraft in the flying display was, however, fitted to carry this bomb and the appropriate modifications will be introduced at a later stage in the production line. To date, two Valiants (now in Australia) and a Vulcan have been equipped to carry Blue Steel.

Vulcan 2s are now replacing Mk. 1s in squadron service and it is expected that the Mk. 1s will be used to equip three new squadrons. The newest anti-radiation finish, as seen at Farnborough, includes pale blue for the national markings, but reports of an all-pink anti-radiation scheme are not correct, this finish having been used on one Vulcan only in connection with special trials in the Arctic.—F.G.S.

An imaginative proposal shown as a model on the Westland stand was this heliport for central London, built out over the Thames and large enough to handle internal and inter-city traffic.



LONG-LIFE AVON.—On Sept. 1 this Avon 524 was removed from a B.O.A.C. Comet 4 after running 1,995 hours without overhaul; it will be reinstalled to run another 305 hours before the engine is overhauled.

Engines and Associated Systems

UNDOUBTEDLY the propulsion theme at this year's Show was the vertical-lift engine—the lightweight jet-lift engine provided one of the principal displays on the Roils-Royce stand, and on the Bristol Siddeley stand the BS.53 lift/thrust engine was the company's prime exhibit. And as practical proof of the jet-powered VTOL aircraft the Short SC.1, "ballerina" of the Show, demonstrated in no uncertain manner the precise degree of control in the air which has already been achieved by this means of propulsion.

Rolls-Royce in emphasizing their strong interest in this field —which, they indicated, dates back as far as 1941—exhibited models of their Flying Bedstead, of the SC.1 and of a hypothetical supersonic transatlantic airliner propelled vertically in the manner propounded by Dr. A. A. Griffith (their chief scientist who retired last month) by multiple banks of small ultra-lightweight jet engines. Work on this type of engine has been under way at Rolls-Royce for some 10 years and some further facts were revealed concerning the Soar and RB.108.

The rise in thrust/weight ratio was demonstrated by comparing the Soar, which first ran in 1952 and achieved a thrust/weight ratio of 6.6 lb./lb., with the RB.108 engine for the SC.1, which first ran in 1955 and gave a corresponding ratio of 8.1 lb./lb. Today Rolls-Royce state that they are working on an engine giving the outstanding ratio of 16 lb./lb. In accompanying literature this engine is shown to be of comparable diameter to the RB.108, but approximately two-thirds the length. (It is rumoured that the engine concerned is designated the RB.162.)

A significant point made by the company is that in an effort to reduce the noise level at take-off with this form of propulsion, work is already proceeding with, among other devices, fans driven by jet engines of this type.

This statement may possibly be associated with the model of a VTOL project study exhibited by Boulton Paul. Designated the P.146, this was a short-range airliner of canard configuration powered by a bank of five small vertically mounted ducted fan engines at each of the tips of the forward wing and a corresponding bank of four units at the tips of the main wing. Two main forward-facing engines provided thrust for normal cruise.

Also exhibited by Rolls-Royce were a number of other new developments backed up by numerous factual statements, these latter being perhaps one of the most impressive features of the company's stand. Latest development of the Avon family is the RB.146R, of similar external configuration to the basic engine and fitted with an afterburner. The dry thrust rating of the engine is 13,220 lb.

Associated with the Tyne turboprop exhibited were illustrations of the aircraft powered, or to be powered, by this engine. These already number six and include the new Transall C.160 powered by two Tynes. The announcement was made that the Tyne, which in its RTy. 11 version produces 5,500 e.h.p. for a weight of only 2,177 lb., is projected for development to 10,000 h.p.—over twice its original output.

The extensive gas-turbine experience of Rolls-Royce was summed up by their claims to more than 13 million hours of operating experience; 80 airlines and 26 air forces using their engines in 54 different countries; and the overhaul life of the Dart now confirmed at 3,000 hr., and the civil Avon coming up for 2,300 hr. The Conway, which was exhibited in its cowling for the Boeing 707-420, complete with thrust reverser and noise-suppressing nozzle also designed and manufactured by Rolls-Royce, has completed a 150-hr. test to type test conditions and has achieved a sea-level static thrust of 20,180 lb.

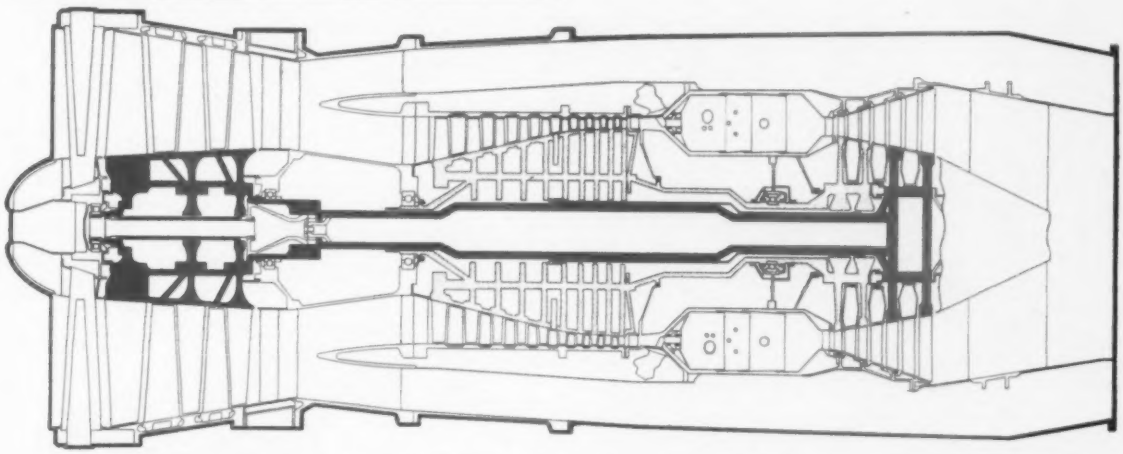
The first of the company's second generation by-pass engines, the RB.141, was shown, with a rating of 15,000 lb. This engine has been chosen for developments of the Sud Aviation Caravelle, and first ran in November last year. Already eight development engines are running and production deliveries are scheduled for late 1961.

It was stated that the RB.163, power unit for the de Havilland Trident, was expected to undergo bench testing in November this year at an initial rating of 9,850 lb. and delivery of production engines should start in late 1961. The engine has the exceptionally high pressure ratio of 16.75 : 1. Photographs were shown of three other recent Rolls-Royce military engines, the RB.153 and 145 turbojets, the RB.168 by-pass engine.

Bristol Siddeley's approach to VTOL propulsion is exemplified by the BS.53 lift/thrust engine shown for the first time this year. This is a high-ratio ducted-fan engine in which provision is made for controlling the direction of its full thrust. The BS.53, which first ran in September, 1959, is supported financially by M.D.A.P. and is the power unit for the Hawker P.1127 VTOL ground attack fighter, shortly to fly.

Contrary to the Rolls-Royce concept for VTOL, the BS.53 combines the vertical take-off thrust rôle with the forward

Final Farnborough Report . . . .



CIVIL TURBOFAN.—This new Bristol Siddeley BS.75 turbofan has a three-stage front-fan driven by the two-stage low-pressure turbine. Its dry weight is 1,485 lb. and its thrust 7,350 lb. By-pass ratio is 1.6:1.

flight thrust rôle, giving an exceptionally simple propulsion system. The engine makes use of Orpheus experience in its high-pressure rotor and to a lesser extent Olympus experience in its low-pressure fan rotor. The by-pass air from the fan is ducted out part way along the engine via two rotatable nozzles incorporating cascades in the elbows, and the hot exhaust passes out via two similar nozzles at the rear.

Because of the high by-pass ratio of the ducted fan the total thrust output is divided more or less equally between the front and rear pairs of nozzles, and the design of the outlets and their linking chain control mechanism is such that the resultant thrust always acts close to the aircraft's centre of gravity. It is in this configuration that the BS.53 is installed in the P.1127.

There are obvious benefits from this form of VTOL engine, the most obvious of which is that one engine is employed for all phases of flight, thus avoiding the need to carry the weight of the "dead" VTOL engines during forward flight as is necessary with the Griffith system. Although it may appear that this divergence of opinion is an interesting successor to the Rolls-Royce by-pass versus Bristol Siddeley ducted fan controversy, it may well be that the BS.53 configuration is more suited to the requirements of military aircraft (such as the P. 1127) involving short to medium ranges; while the Rolls-Royce system in which the forward propulsion engines can be designed solely for the cruise case provides a more apt answer for the longer-range commercial aircraft.

Undoubtedly the total engine-plus-fuel weight with the Griffith technique is ultimately less over a certain range, because of the better cruise s.f.c., than is the case with the Bristol Siddeley method where the engine is inherently too powerful for cruising requirements. Perhaps strengthening this argument is the point that an engine of the BS.53 configuration is amenable to the use of afterburning of the fan air and exhaust gases at take-off, a procedure which would obviously not be acceptable to civil operators.

Other Bristol Siddeley exhibits of interest included the Stentor HTP rocket for the Avro Blue Steel stand-off bomb being shown for the first time. Also there was an Olympus 21 of 20,000 lb. thrust fitted with the Bristol Siddeley development of the American Solar reheat system; applied to the Olympus (but not the 21) this enables a thrust output of no less than 33,000 lb. to be achieved. On the basis of the typical 40-50% thrust boost achieved by modern afterburners this implies the existence of a later Olympus of around 23,500-22,000 lb. output.

Existence of a further development of the Bristol Siddeley series of ramjets was evidenced by the display of a BSRJ.824 unit of 18-in. diameter.

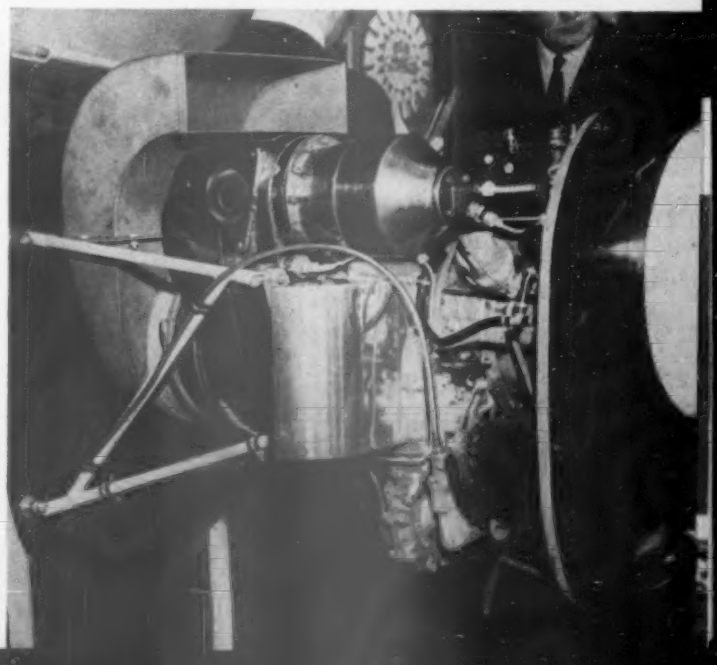
Details were also revealed for the first time of the BS.75 ducted fan engine of 7,350 lb. thrust. This is aimed at the various short/medium-range jet transport aircraft currently being designed by a number of British companies—at least two of these, the Hunting BAC.107 and the Avro 771, were exhibited in model form, specifying the BS.75. The engine is to have an s.f.c. some 10% lower than that of a comparable turbojet under cruising conditions, and at sea level static is to give 0.508 lb./lb./hr. It measures 89 in. long by 33.4 in. diameter and because of its high by-pass ratio, and hence low jet velocity, is claimed to achieve a 15 decibel reduction in noise level at take-off compared with a turbojet.

Another point of interest on the Bristol Siddeley stand was the indication given of the company's views on supersonic propulsion. These are represented by an unreheated turbojet for Mach 2, involving a derivative of the Olympus; a duct-burning turbofan for Mach 3 involving a derivative of the BS.53; and a combination engine system incorporating a turbojet for take-off and low-speed flight, and a ramjet for cruise flight for speeds in the region of Mach 4.5.

Among the other companies there was an emphasis on the smaller size of engine, with a particular bias towards helicopter power units. Alvis exhibited Leonides Series 554 and Leonides Major Series 750 engines for rotary-wing applications. Blackburn Engines with current versions of the Nimbus, Palouste, Turmo and Artouste A.A.P.P. for the Victor B. Mk. 2 and the Canadair CL.44, emphasized the application of the Nimbus in the Westland P.531-2 and Sprite. This Nimbus free turbine unit is specified for the forthcoming four-engined SRN-2 hovercraft.

De Havilland Engines were showing the Coupled Gnome H.1200 comprising two Gnome engines and a coupling gearbox currently under development for the Westland Wessex Mk. 2.

(*Continued on page 414*)



ROVER TURBOPROP.—This pusher turboprop version of the Rover 1S/60 airborne auxiliary power unit was exhibited by Rover Gas Turbines, Ltd. It develops 70 b.h.p. for take-off.

Photograph copyright "The Aeroplane and Astronautics"

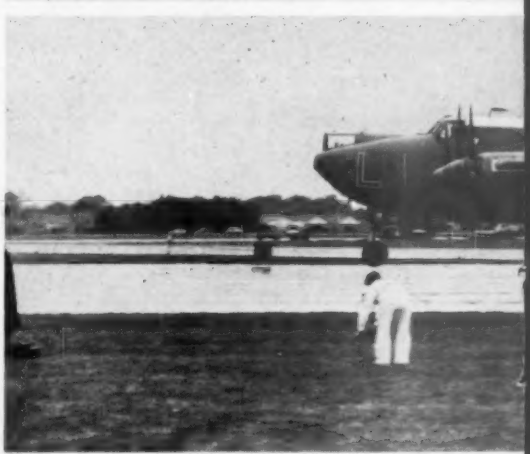
AT THE SHOW—1

Left, Treble One Squadron makes its spectacular entrance with 18 Hunters streaming smoke.

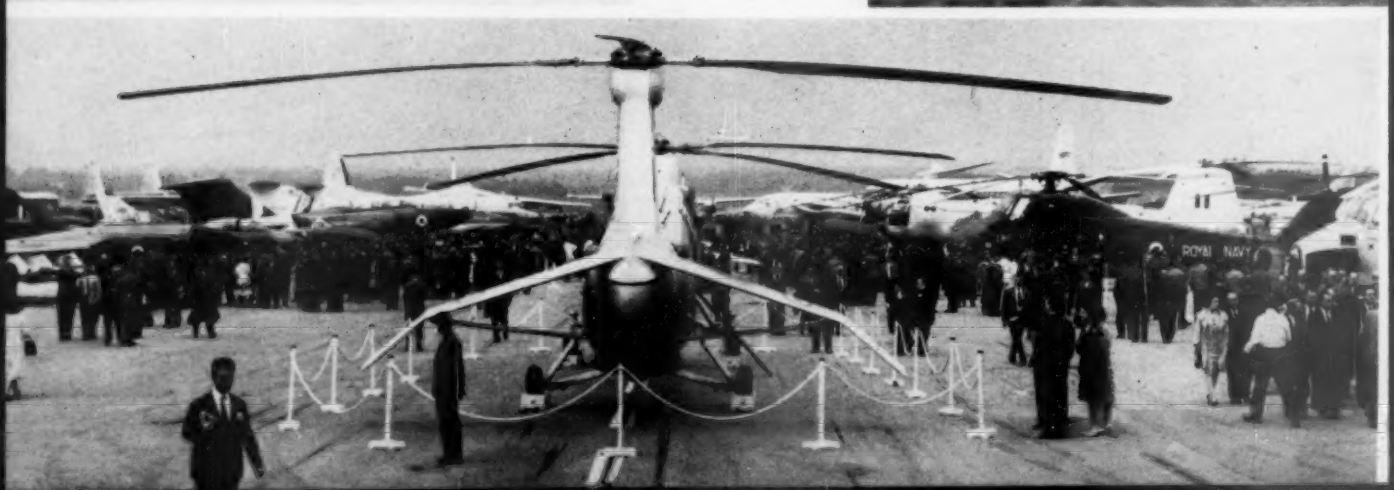
Photographs copyright "The Aeroplane and Astronautics"

Right, well equipped with "stores" the de Havilland Sea Vixen for the Royal Navy makes a steady "arrival."

Left, the Rotodyne VTOL airliner was a dominant item in the Westland Group's rotary-wing "circus."



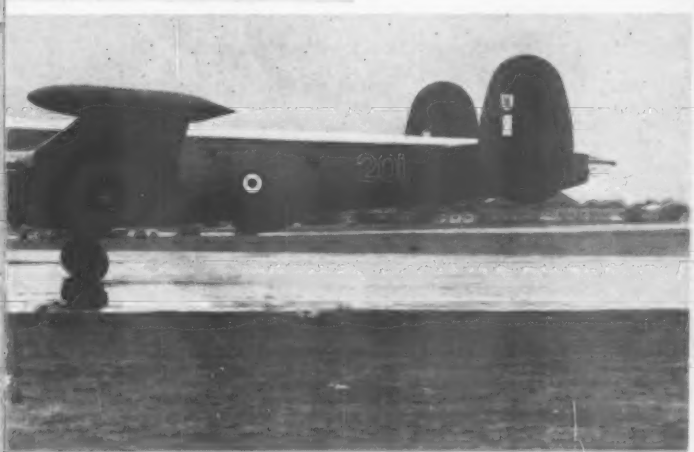
Below, a large crowd of technicians inspected the aircraft on the opening Monday of the Show.

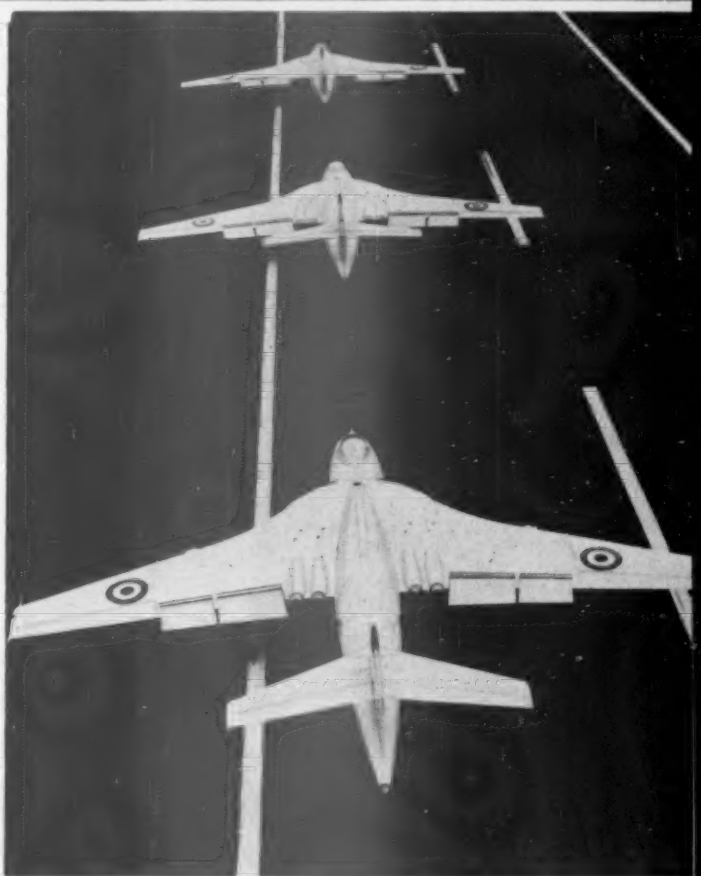


Above, the finale of an impressive display by the two Blackburn Buccaneers.

Right, three Valiants prepare for the V-bomber "scramble" which opened the flying display each day.

Below, setting off on a 20-hr. patrol, a Shackleton takes off from Farnborough to return to the Show the following day.





Below, the Handley Page Victor 2 streaming its braking parachute in a smooth touch-down.

Engines and Associated Systems . . . .

(Continued from page 411)

Also exhibited for the first time were a production version Gyron Junior Mk. 101 of 7,100 lb. thrust, and the Gyron Junior D.G.J.10 fitted with the reheat system developed for this engine installed in the Bristol Type 188. Internal details of the afterburner were apparent and also the use of eight pairs of small Hobson pneumatic jacks for operating the multi-petals of the variable-area, variable-geometry nozzle. It was announced that the turboprop version of the Gnome, the P.1000, had made its first run during the Show, on Sept. 5.

Napier was also highlighting its particular interest in helicopter gas turbines, and was showing a model of the Gazelle 512. This had been modified relative to earlier versions of this engine in that the output drive is now direct from the mechanically free power turbine, the entire speed reduction being undertaken by an airframe-mounted gearbox—as is becoming common practice on modern helicopters. In addition the engine now has a more conventional axial intake, although it can also be made available with a radial inlet.

The Gazelle 512 is the power unit concerned in a design study by Vertol of their model 107 helicopter. With this engine the aircraft can carry an extra three passengers and has an improved single-engine performance.

Research compressors for this engine were exhibited. For increased power versions of the Gazelle the RB compressor has been developed giving 20.9 lb./sec. air mass-flow compared with 16.6 lb./sec. of the production compressor. The respective pressure ratios are 7 : 1 and 6.2 : 1. The Rig 2A compressor for higher pressure ratio giving a lower s.f.c. had achieved 11 : 1 at 17 lb./sec. Here the power consumption rose from 2,200 b.h.p. to 5,000 b.h.p.

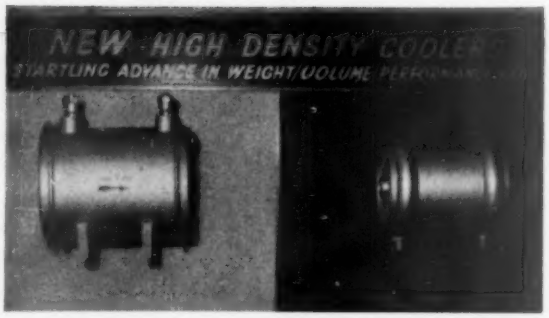
Rover Gas Turbines, Ltd., in the Equipment Park exhibited a wide variety of their small gas turbine units including their A.A.P.P., as employed in certain of the V-bombers and fitted with a special high-altitude fuel system and a modified starting system giving reliable engine starting at altitudes in excess of 45,000 ft. The units are fully M.o.A. and A.I.D. approved.

A new Rover venture is their small turboprop of 60 and 90 b.h.p. output. In the configuration shown the engine has a pusher airscrew incorporating a variable-pitch mechanism of the company's own design and manufacture; the engine has been flown in the Currie Wot. It is hoped to install it in a Gemini, in which case the twin intake and single exhaust duct are reversed in direction.

Rovers have now accumulated a considerable background of operating experience and industrial versions of their engines are being returned for overhaul after as much as 3,000 hr. of service. Their range of engines covers marine as well as industrial and aircraft applications, and the new T.P.60 and 90 turboprops are aimed at introducing the private flyer to the benefits of turbine power.

Among the ancillary manufactures Lucas were exhibiting an interesting development in combustion chamber design known as the equi-velocity sampling or E.V.S. system. This corrects any radial maldistribution in the airflow to the combustion system as is common with axial compressors.

Two examples were shown. One is for a fully annular chamber such as the de Havilland engines have. In this the annulus of flow is divided into a large number of equal radial segments, alternate segments feeding primary air for combustion and secondary air to the inner portion of the flame tube. The intermediate segments feed secondary air to the outer portion of the flame tube. For cannular systems such as used on Rolls-Royce engines, the annulus of flow is again divided into a series of radial segments, alternate segments of flow being deflected outwards and inwards.



LIGHTER COOLER.—Advances in air-cooled oil-cooler techniques were shown by Delaney Gallay. The new cooler on the right has the same work capacity as the old version on the left.

Both of these configurations result in an averaging-out in a radial sense of the fast and slow flows of air entering the combustion system. This gives improved combustion performance and better inlet temperature distribution to the turbine.

Heenan and Froude, large manufacturers of engine test equipment, were exhibiting a new constant-speed, hydraulic dynamometer—designated the P.T.20—for absorbing powers up to 6,000 h.p

In another field, Delaney Gallay were showing a new type of air-cooled oil cooler which gives considerable reductions in weight and size compared with more conventional coolers. The new designs incorporate a greater number of closer-pitched air tubes, and the oil, instead of passing to-and-fro across the cooler between a system of baffles, is directed to the axis of the cooler. It then proceeds radially outwards and inwards again, under the control of baffles, to the rear end of the cooler. The technique can also be applied to reduce the size of fuel-cooled oil coolers.

Bristol Aerojet illustrated two new developments concerned with the manufacture of rocket casings. Chemical contouring techniques have been evolved for use with high tensile steels and an example of this was shown, indicating how integral stiffening contours can be produced accurately on cylindrical surfaces.

This introduces the possibility of manufacturing double-skinned casings with sandwiched stiffening contours, i.e., a plain outer cylinder welded to a contoured inner cylinder. In effect the process achieves an inexpensive form of honeycomb construction. Also shown was a sample of helical welding allowing larger diameter cylinders to be produced where a limit would otherwise be experienced in the width of sheet steel available if a purely axial weld is employed.

The Ministry of Aviation had a number of well-presented exhibits associated with engines. A film on the work of the National Gas Turbine Establishment described the mechanism of thermal fatigue on turbine nozzle and rotor blades and showed some of the basic research work being performed to investigate this phenomenon. Exhibits were included to illustrate some of the experimental techniques developed by the Rocket Propulsion Establishment to examine the processes taking place inside the combustion chamber and nozzle of liquid propellent rocket engines.

A combustion chamber with a large semi-transparent window enables very high-speed photography to be performed over the course of one or two seconds and enables the flame patterns produced by different designs of fuel injector to be studied. A water-cooled combustion chamber which can be operated continuously for long periods was shown; in this the sectional construction enables the length and diameter of the chamber to be altered and so facilitate investigation of the influence of chamber shape and injector design over a wide range of test conditions.—K.T.F.

COMBUSTION TECHNIQUE.—Improved airflow distribution and combustion is given by Lucas combustion chambers employing equi-velocity sampling; the technique is described in the text.

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GOODYEAR

AVIATION DIVISION

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PEOPLE AT THE SHOW

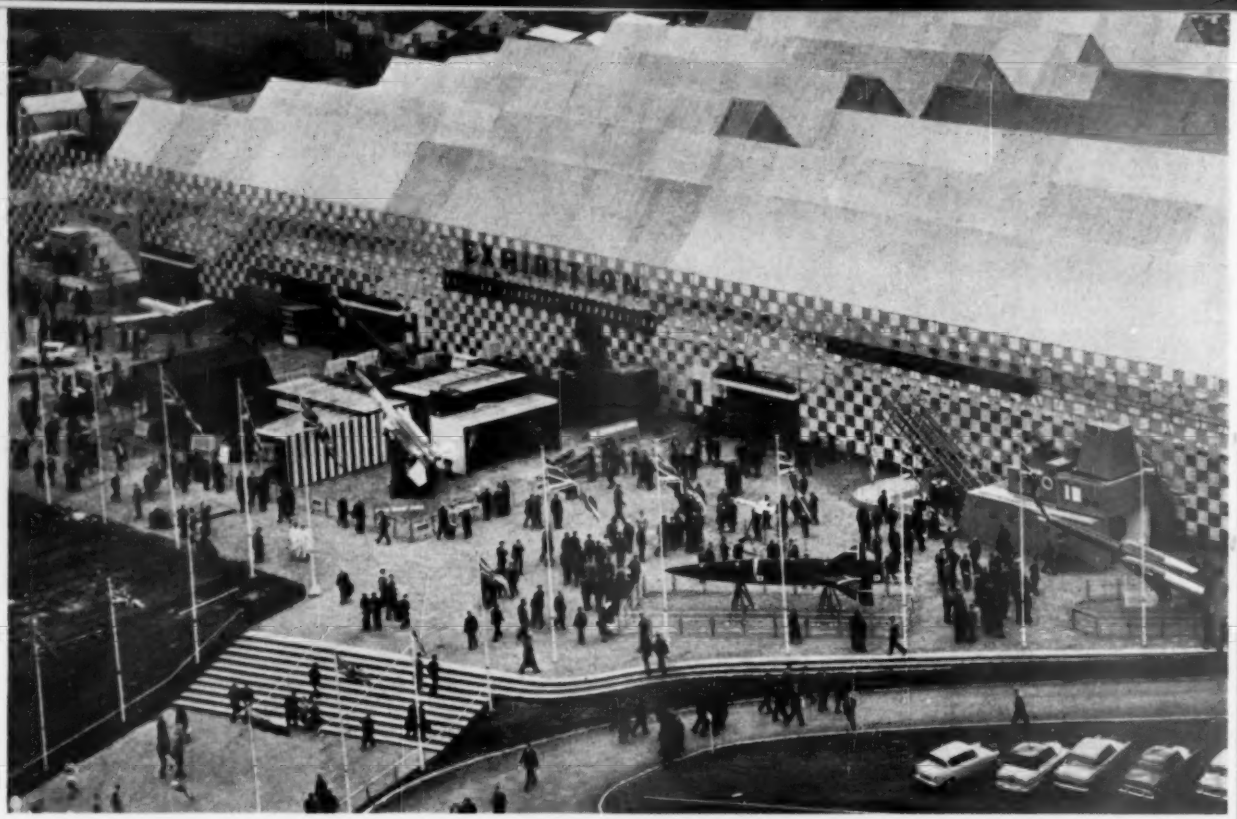
Photographs copyright "The Aeroplane and Astronautics"

Above, Sir George Dowty, president of the S.B.A.C., with the Secretary of State for Air and other distinguished visitors from home and overseas watch the flying from the president's pavilion.

Left, l. to r., Vice-Admiral L. G. Durlacher, Fifth Sea Lord and Deputy Chief of Naval Staff; Air Marshal Sir Edward Chilton, A.O.C.-in-C., Coastal Command; Admiral Sir Caspar John, First Sea Lord and Chief of Naval Staff; Capt. J. A. R. Troup, Naval assistant to the First Sea Lord; and Vice-Admiral W. J. W. Woods, C.in-C. Home Fleet.

Right, the Secretary of State for Air with the A.O.C.-in-C., Bomber Command, Air Marshal Sir Kenneth Cross, discuss the Vulcan scramble with aircrew from No. 617 Squadron (Wg. L. Cdr. G. A. Bastard—extreme right).

Below, the industry's test pilots receiving their daily pre-display briefing.

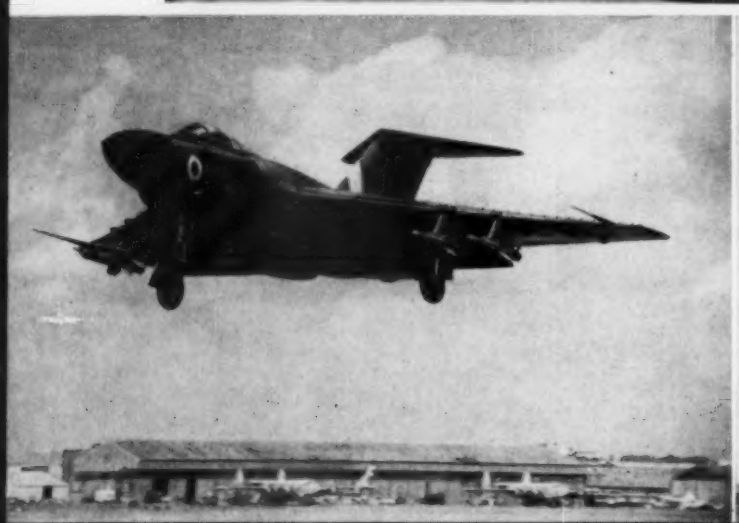


AT THE SHOW—2

Photographs copyright "The Aeroplane and Astronautics"

Above, the four-seat Auster D.6/180, derived from the Autocar with a wider fuselage and more span. Left, the two-seat D.4/108 is the smallest of the Auster D range.

Below, left, bristling with four Firestreaks and carrying two slipper tanks, the Gloster Javelin FAW.9 shows off its slow-flying capability. Below, right, the Twin Pioneer flying happily with its port airscrew feathered.



Right, one of the outstanding performances in the flying display was that of the Handley Page Herald which, with 30 troops aboard, took-off and landed in the remarkably short distance of 600 yd.

Left, the latest version of the Jindivik pilotless target aircraft on view in the guided missile park.

Above, the Bristol-Ferranti Bloodhound in its production form as deployed with R.A.F. squadrons.

Below, with its four Tynes quietly idling the Vickers Vanguard second-generation turboprop airliner touches down on the wet Farnborough runway.

Above, latest of the Hunting Jet Provosts, the T.Mk.4, was a private venture development; a batch has now been ordered for evaluation by the R.A.F.

Final Farnborough Report . . . .

Satellites and Missiles

Photographs copyright "The Aeroplane and Astronautics"

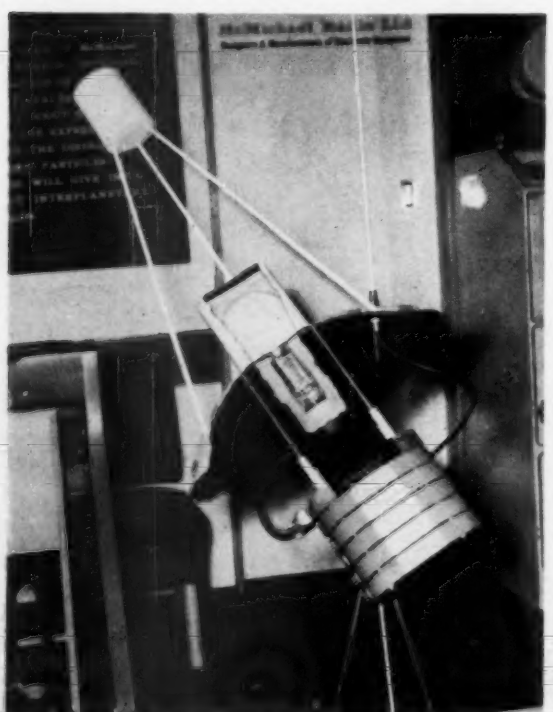
An impressive line-up of English Electric Thunderbirds. Throughout the Show missile handling was ably demonstrated by men of the 60 Guided Weapon Battery, 36 Guided Weapon Regiment, R.A.

JUST over 10 years ago, the first guided missile exhibits began to make their appearance at the S.B.A.C. Show. This year, we have seen the first examples of work with satellite equipment.

On the stand of McMichael Radio, for example, was a full-size mock-up of a section of the first Anglo-American satellite which is scheduled to be launched by the four-stage Chance-Vought Scout rocket in the latter part of next year. McMichael is providing apparatus for a cosmic-ray experiment under the supervision of Prof. H. Elliot of Imperial College. The object of the experiment is to plot the distribution of heavy cosmic particles around the Earth, and to use this information to test theories concerning interplanetary magnetic fields.

The apparatus consists of two basic sections. One is a channel to measure the general level of radiation, including the levels in the Van Allen belts (the satellite is expected to have an apogee of about 600 miles and a perigee of about 200 miles); this channel is headed by a Geiger-Müller tube designed to work at high radiation levels.

The second channel utilizes a phenomenon known as the Cerenkov effect to count the number of heavy cosmic particles. Cosmic rays consist of particles—atomic nuclei of varying weights—which travel at speeds close to that of light *in vacuo*. When these particles pass through a transparent material such as Perspex, they may be travelling faster than the speed of light in that substance. In these circumstances, a "shock-wave" analogous to that produced by an aircraft exceeding the speed of sound is set up which manifests itself in the form of a flash of light. In practice, this flash is of such low intensity as to be undetectable to the eye, and of millimicro-second duration.



Scout satellite exhibit by McMichael Radio, showing equipment for the Imperial College cosmic ray experiment "mocked-up" on a section of the 20-in.-diameter satellite shell.

In the satellite equipment, these flashes, produced in a Perspex sphere, will be picked up by a photomultiplier tube and subsequently processed by the associated electronic equipment. Storage circuits are provided in a module 2 in. thick by 7 in. dia., which will form one of a stack of modules disposed on the axis of the satellite. This C.R. module contains printed wiring and is entirely transistorized. An essential part of the equipment are McMichael-developed binary counters which will store information on heavy cosmic particle densities for subsequent transmission to Earth by radio-telemetry.

A binary counter is a device that emits one pulse of energy for every two pulses of energy it receives. That is to say, it is a device which can divide by two. It will count pulses that are as short as two millionths of a second and occurring as fast as one hundred thousand pulses per second. It consumes very little power. In fact, 40 or more binary counters can be energized for the power consumed by a small flashlight bulb.

Examples of these remarkably small binary elements were to be inspected on the McMichael stand. The type R.10 takes the form of a ½-in. cube weighing ¼ oz., yet it contains two germanium transistors, two germanium diodes, four ceramic capacitors, and eight resistors. The component density is, in fact, the astonishing figure of 221,000 per cu. ft.

Configuration of the satellite itself is based on a 20-in. sphere. The cosmic ray apparatus will be contained symmetrically about the spin-axis at one end of the satellite, with the Perspex sphere and photomultiplier mounted in plastic foam within a cylindrical container which projects beyond the external skin. Mounted about this unit on a tripod support may be a probe for measuring electron density, but precise details of this are not yet available. A stack of modules supported by four shock-absorbing rods at both ends of the satellite will contain the analysing and memory circuits for the various experiments, as previously described.

Although precise information is lacking, it appears that the external surface of the satellite will be covered by rings of solar cells; three or four rod antennæ will project from the equator of the satellite.

A British Communications Satellite

On the Hawker Siddeley stand was a ½-scale model of the telephone relay satellite proposed by the Astronautics Section of Hawker Siddeley's Advanced Projects Group under Dr. W. F. Hilton. The orbital characteristics and basic design features of this interesting project were given exclusively in THE AEROPLANE AND ASTRONAUTICS on Aug. 12, 1960. The most attractive orbit would appear to be elliptic inclined at about 63° to the equatorial plane. The apogee would be at latitude

(*Continued on page 419*)

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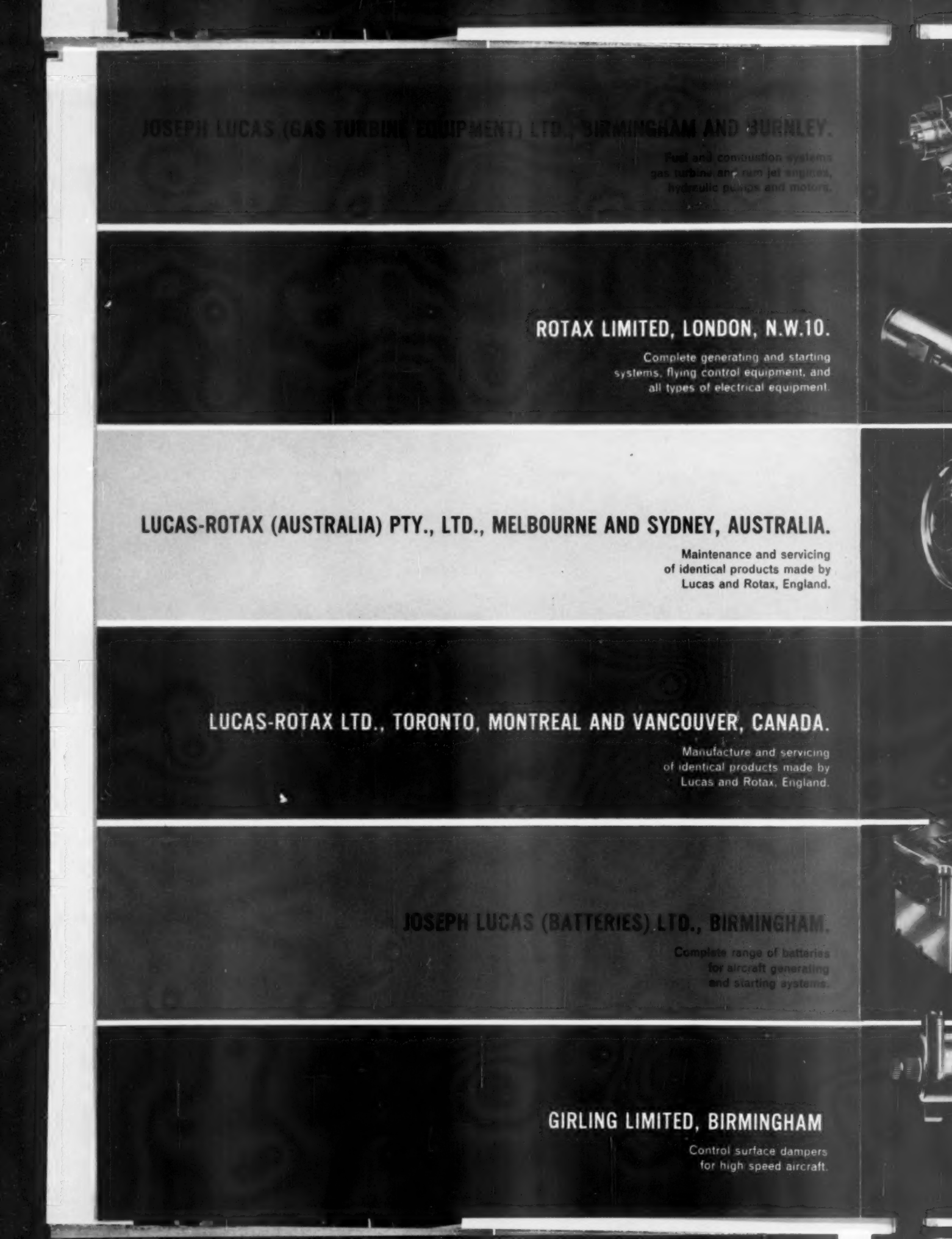
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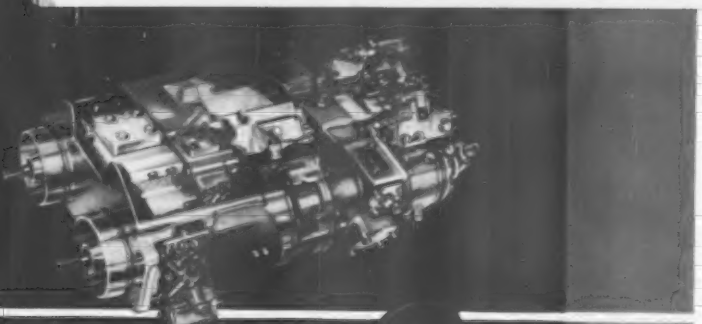

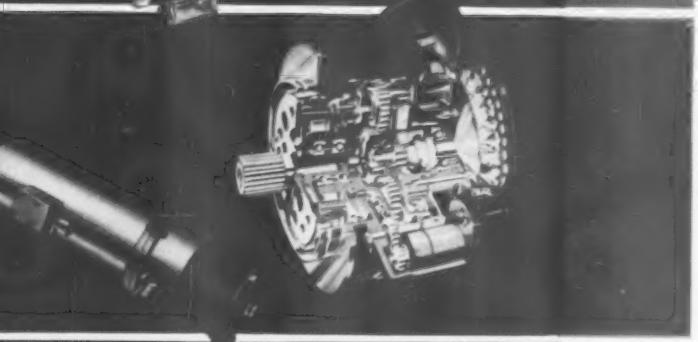

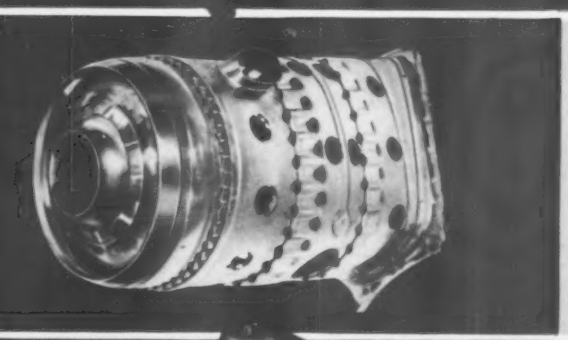

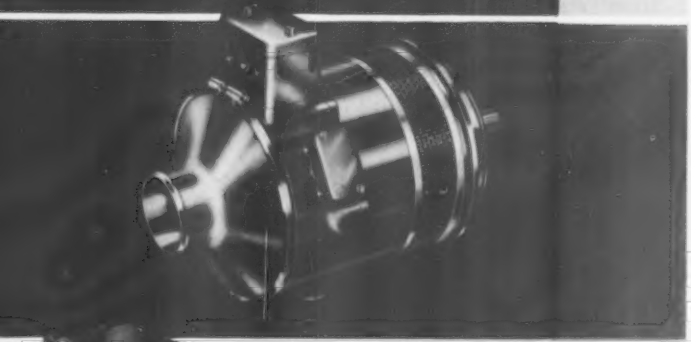

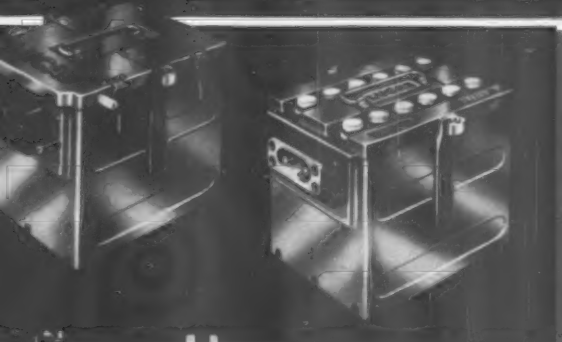

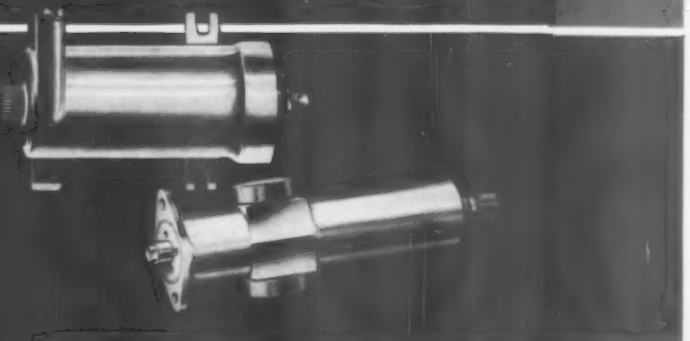

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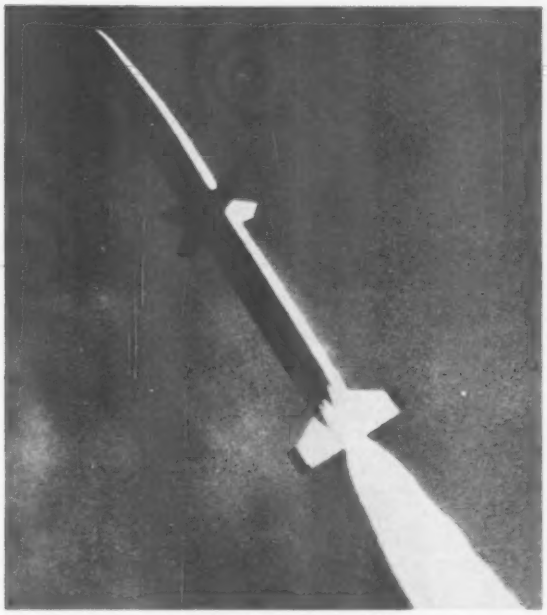


First picture of a test-vehicle for the English Electric Blue Water Corps-support missile which is inertially guided and powered by a solid-propellent rocket motor.

(*Continued from page 418*)

63° north at a height of about 12,500 miles and the perigee at a height of some 300 miles in the southern hemisphere.

Properties of the elliptic orbit—as graphically outlined in a colour film shown continuously on the Hawker Siddeley stand—are such that the satellite spends a large proportion of its periodic time in communication. It is found, for example, that with one satellite giving about 9 hr. a day communication, three satellites correctly disposed should give nearly 24-hr. coverage.

The satellite itself is a spaceborne radio-receiver and transmitter having an antenna "dish" of 3 ft. dia. providing 100 speech channels at 450 mW. per channel. To ensure sufficient ground receiver strength the transmitting aerial is directional and hence rough Earth-seeking attitude stabilization is necessary. In the Hawker Siddeley design, this would be accomplished by means of a flywheel system activated by horizon sensors. The 500 W. power demand would be met by mounting solar cells on four "petals" which remain folded before satellite separation from the rocket carrier but open out once it is in orbit.

The transceiver, stabilization and control equipment were shown in the model mounted on a platform within the main body structure with the radio "dish" antenna forming the base of the assembly. Four strong points on the perimeter of the reflector secure the satellite to the third stage. A light-alloy skin would enclose the main body of the actual satellite through which would protrude the horizon sensing unit and the H.T.P. jets. The latter are intended to de-spin the satellite after separation and would also serve to "de-saturate" the flywheels when necessary. Total satellite weight would be between 600 and 700 lb.

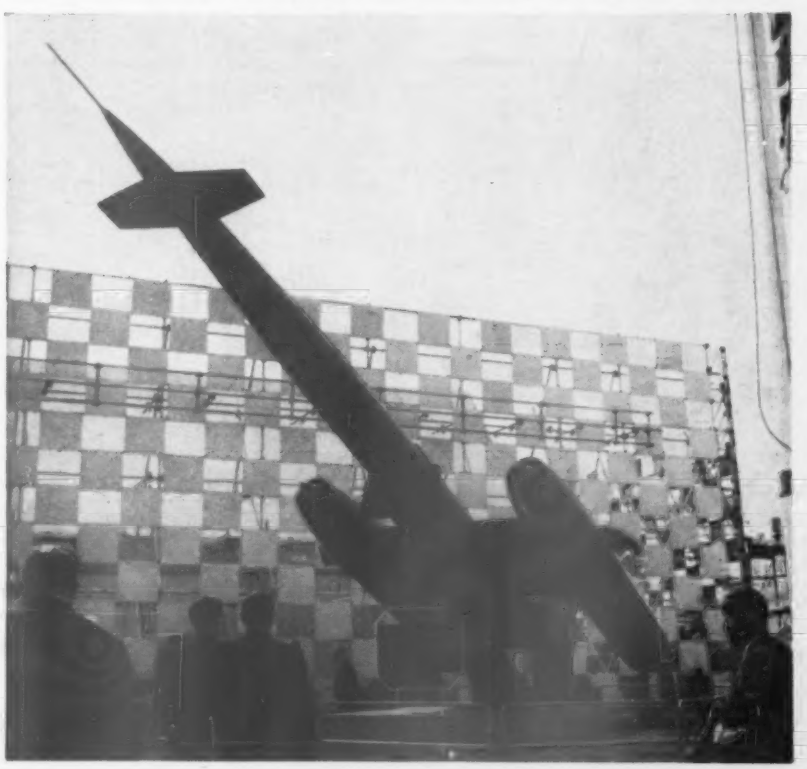
It is estimated that a useful satellite could be put into orbit by mid-1964 with subsequent firings at about three-monthly intervals, if an order to proceed is received in the near future.

Continental Supersonic Target

An interesting "missile" exhibit from France was to be found at Farnborough in the Guided Weapons Park in the shape of the Nord C.T. 41 supersonic target. It gained its admission to the Show by virtue of a licence-agreement with Hawker Siddeley which provides for servicing, maintenance and possible manufacture by Armstrong Whitworth Aircraft, Ltd. It is understood that the C.T. 41 may be the subject of an order in the near future to provide for the evaluation of "second-generation" British missiles at realistic altitudes and speeds. Speed range is between Mach 1.5 and 2.5 at 65,000 ft.

The C.T. 41 is a twin ramjet missile, ramp-launched by two solid-propellent boosters. It is radio-controlled and recoverable. Possessing outstanding performance, it can climb to 65,000 ft. at Mach 2.0 in 80 sec. and has an endurance of some 14 min. at that altitude.

Ease of recovery is a major feature of the design. First, the rear section of the target, which includes the fin, is released by explosion of the four bolts securing it to the central section, and the brake parachute deploys and opens. When the correct conditions of speed and altitude are obtained, the nose section and its parachute are released. The central section then turns through 180° under the action of the brake parachute and the



A French twin-ramjet target missile in the Mach 1.5-2.5 category at 65,000 ft., the Nord C.T. 41 gained its place at Farnborough by virtue of a licence-agreement with Hawker Siddeley providing for servicing, maintenance and possible construction in Britain.

Photograph copyright "The Aeroplane and Astronautics"

main parachute is extracted and recovers this part of the missile.

Design of the C.T. 41 is such that the missile is easily transportable, particularly by air. It breaks down into five main sections which can be delivered in separate boxes: (1) central section; (2) fuselage centre-section and wing; (3) nose section; (4) front fuselage and horizontal stabilizer; (5) rear section, rear fuselage and fin and two ramjets.

Its length is 32 ft. 2 in.; wing span, 11 ft. 11 in.; max. fuselage dia., 1 ft. 8 in.; wing area, 33.26 sq. ft.; and weight 2,865 lb. including 1,100 lb. fuel. With solid-propellent boosters (1,765 lb.) and booster cradle (990 lb.) the total launching weight is 5,620 lb.

Seacats " in action "

Another interesting feature of the Guided Weapons Park was a demonstration of how the Short Seacat anti-aircraft missile might be operated aboard a typical destroyer. Throughout the show men and women of the Royal Navy carried out simulated operations of Seacat launching equipment mounted on the destroyer " deck," which included a launcher with four dummy missiles, a director, and a magazine where further missiles were stowed and where a loading crew would normally shelter during action.

The director is manned by two ratings. One of them—a control officer—stands by and moves the director around in such a way that the second rating, the aimer, who sits in the director " bin," can pick up any aircraft within his vision. As the aimer follows the target through binoculars, the launcher follows suit, so that when a missile is fired it will fly into the aimer's field of vision. The aimer can then command the missile by means of a radio link, through which instructions to climb, dive, or go left or right, are passed to the missile's wings via the radio-control receiver. The aimer simply guides the Seacat into coincidence with the target aircraft by means of a control column.

Reloading is a simple procedure. After the four missiles have been fired, the control officer commands the launcher to swing towards the magazine. The loading rails are tilted down to receive the new missiles which are carried from the magazine to the launcher in glass-fibre canisters designed for easy and rapid handling. As each missile is placed in position in the launcher its canister is removed and the weapon is ready for immediate action.

Firestreak Success

Now in operational service with the R.A.F. and Royal Navy, the de Havilland Propellers Firestreak could be seen in various parts of the Exhibition—aboard Javelin, Sea Vixen and Lightning aircraft, on the Hawker Siddeley stand and in the Guided Weapons Park. During the last R.A.F. Fighter Command Air Defence Exercise, many sorties using Firestreak were flown and the success achieved by the weapon was rated at over 90%. Progress with the more advanced weapon, Red Top, is still closely shrouded.

Anti-tank missiles were also well to the fore and both Vickers and Pye included interesting display features. For example, the Vickers Vigilant is not only considered to be a handy infantry weapon but, because of its small size and weight, it is readily adaptable for fitting to light reconnaissance vehicles such as the Ferret. The weapon was, in fact, shown in conjunction with this vehicle. In a paratrooper rôle, the time from landing to " ready to fire " is less than one minute, while in the case of an infantryman the time from carrying to " ready to fire " is only 10 sec.

Similar arguments regarding size and weight apply to the Pye Python which was shown in dummy form mounted on a three-wheeled, highly manœuvrable vehicle of Belgian design and manufacture—the F.N. Véhicule Aeroporté A.S. 24. This is perhaps best described as a one-man motorized tricycle and looked particularly effective as a light missile carrier. Both vehicle and missile can be collapsed to reduce their overall dimensions for air transport and are suitable for parachute delivery.

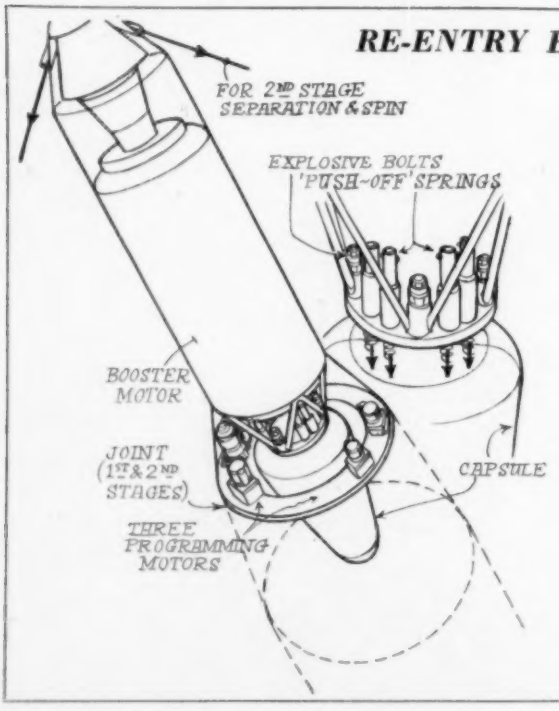
On the Bristol Aerojet stand was to be found a solid-propellent " flight test vehicle " designed for payload recovery. Object of the exercise is to lift an instrument package to a predetermined altitude, whence the payload is jettisoned to descend by parachute. The company is working with the Meteorological Office on the design of a small meteorological rocket for launching from weather ships.

As is well known, Bristol-Aerojet are responsible for making the majority of solid-propellent motor cases used in British missiles and as such they are constantly seeking to improve manufacturing techniques. For example, large diameter, thin walled tubes are difficult to combine with close tolerances. This has led to a method of helical welding whereby precision tubes of constant diameter can be made from strip with the weld region free from misalignment. The sample shown at Farnborough, of 17 in. diameter, had been produced from 6-in.-wide 0.048-in. strip in 3% chromium molybdenum steel.

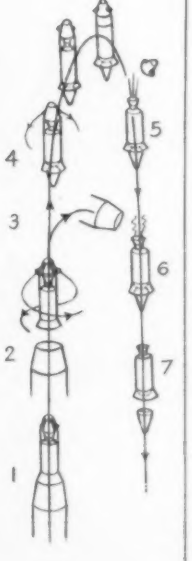
Shapes which may play a leading part in aerospace research were to be found among the exhibits of Bristol Aircraft, Ltd. Here it was pointed out that aerodynamic configurations used in hypersonic flight will stem from three simple geometric shapes combined in various ways. These were a sphere, a cylinder and a cone. Derived from these shapes were half-cones, wedges and delta-wedges which led directly to two " boost-glide " concepts—a dart-like wedge married to a conic-cylindric fuselage, and a dart-wing having two stages of anhedral and a half-cone under-fuselage.

Such configurations, it was stated, have been tested in a wind-tunnel at speeds up to Mach 10.0.—K.W.G.

RE-ENTRY EXPERIMENTS



Left, upper section of the two-stage Saunders-Roe Black Knight showing the solid-propellent top stage mounted nozzle-forward for re-entry experiments. After separation, backward-facing rocket is spin-stabilized in a vertical attitude to drive re-entry capsule down into the atmosphere at high speed on return leg of the trajectory. Also shown is the separating mechanism of the re-entry capsule.



KEY

Right, trajectory diagram. 1, Black Knight first stage at " all-burnt." 2, Separation and spin-up of second stage by inclined nose-jets. 3, Expended first stage. 4, Second stage coasts nozzle-forward in vertical attitude to a height of about 370 miles. 5, Second-stage ignition marked by pyrotechnic flash at 60 miles' altitude. 6, Second stage at " all-burnt," speed approx. 10,000 m.p.h. 7, Separation of spinning re-entry capsule at 40 miles' altitude.

Drawings by J. H. Clark, A.R.Ae.S. Copyright "The Aeroplane and Astronautics".

Farnborough Flashes

Gnat Development

Of the six Folland Gnat trainers flown to date, the fourth (XM694) is the first to have integral fuel tanks in the wings.

Trident Versions

While production of the B.E.A. Trident 1 is proceeding, de Havilland are putting design effort into developing a Trident 2 for ranges up to 2,200 naut. miles. The Trident 1 will initially have a gross weight of 105,000 lb., and is for stages of up to 1,000 naut. miles, but a centre section fuel tank will be available to increase the range to 1,400 naut. miles, with an initial take-off weight of 112,000 lb. The stub wings have now been attached to the first Trident fuselage at Hatfield. A flutter model for the Trident has been constructed and tested by Handley Page, Ltd.

Above, pride of place on Martin-Baker's stand was taken by this GQ5 fully automatic ejection seat for the F104G Starfighter. Right, the Folland fully automatic ejection seat.

Suction Surfaces

Handley Page exhibited three types of suction surface for laminar-flow aircraft. A surface with thin suction slits is preferred for swept-wing aircraft; these would have a sintered nickel surface over high-suction areas where slits would need to be too close. An earlier type of pin-holed surface is suitable for unswept wings.

Towed Flare

A Jindivik Mk. 2B pilotless target aircraft produced by the Government Aircraft Factory, Melbourne, Australia (European agents, Fairey Engineering, Ltd.) was shown with an infra-red source fitted to the port side of the rear fuselage. Beneath the fuselage was a finned canister for an IR-flare which unreels on a 100-ft. line below the target for evaluation of heat-seeking missiles.

New Motor Cases

Bristol Aerojet has developed helical welding techniques which can be used in the production of large-diameter cases for solid-propellent rocket motors.

Portable Silencer

Flight Refuelling, Ltd., is finalizing a licence agreement for manufacture of the Curtiss-Wright CWXL-1 exhaust noise suppressor. This mobile suppressor will reduce the overall noise level of turbojet engines by 30 to 35 db. during ground running.

Conway Stage 7

Vickers latest brochure on the Super VC10 indicates the use of Rolls-Royce Conway Stage 7 engines at a take-off thrust rating of 24,000 lb. Specific fuel consumption during the cruise is quoted as 0.758 lb./hr./lb.—a further improvement on the s.f.c. of the Conway RCo.42s in the initial VC10 versions.

Smooth Integration

A senior member of the staff of one of the companies now "integrated," remarked that their merger seems to have been effected so smoothly that there had been no noticeable change—except that is, when it came to the planning of their contribution to the joint Farnborough stand.

Belvedere Tails

After several intermediate stages, a final tailplane arrangement has been developed for the Westland Belvedere and was seen on XG452 in the static park at Farnborough; that on XG451 in the flying display was an interim version. The first Belvedere squadron is in process of formation at Odiham.

Nice Timing

As the last Valiant "scrambled" away during the Show curtain-raiser on Monday, newspaper sellers could be seen displaying bills starkly announcing "Russian Threat—Sensation." It took a minute or two to appreciate that this had something to do with the Olympiad in Rome.

NEWS of five contracts for British aeroplanes was announced or confirmed during Farnborough week. In order of announcement they were as follows:—

D.H. Comet 4C. Five are to be purchased by R.A.F. Transport Command, for delivery during 1961 and 1962. Total Comet 4 orders are now 56.

A.W. Argosy. Sixteen more of the AW660 version ordered for Transport Command, making a total of 56.

H.P. Herald. Six of a longer-fuselage version were ordered by Jersey Airlines, with deliveries to begin next June.

Avro 748. B.K.S. took up an option on three to bring its total to five and the firm orders placed with Avro for this type to 15.

Westland Sprite. A "substantial number" of the six-seat Saro helicopters was ordered by the M.o.A. for the Army, following deliveries of pre-production models earlier this year.

Other orders were being spoken of at Farnborough as being near to confirmation. Among the more certain of these were a further batch of Hunting Jet Provosts for Ceylon, a batch of Rotodynes (probably Eland-engined) for the R.A.F., and some long-fuselage Heralds for Brazil.

Cutaway Missile

A Pye Python wire-guided anti-tank missile, shown in cutaway form, revealed the following equipment, nose to tail: Detachable warhead, servo amplifiers, roll reference gyro, signal wire coil (near leading edge of wings), power and junction unit, boost motor, and roll stabilized control unit.

Portable Accommodation

Two ingenious methods of providing shelter for people and equipment were displayed by P. Frankenstein. One was a polyurethane rigid foam-covered fabric "dome" that can be put up in 2-3 hr. from air-dropped equipment; the inflated fabric envelope is sprayed inside and out with the polyurethane in liquid form. The other shelter comprises a fabric envelope over an inflatable tubular frame rather like a perambulator hood frame. Both were devised by Mr. W. Neumark.

Frankenstein's "Clamshell" shelter of proofed fabric over an inflateable tube frame.

Farnborough Flashes . . . .

Javelin Refinements

Modifications to the wing of the Javelin 8 and 9 for higher speeds which result from the after-burning engines include the addition of a third row of turbolators (vortex generators) on each outer panel. No Javelin 9s have been built as such, but most now reaching the squadrons are Mk. 7s converted before delivery.

Creditmanship

Prize for the largest number of times a company's name could be made to appear in any one exhibit must go to Blackburn Aircraft. These two significant words appeared no less than 168 times around the two Buccaneers in the static aircraft park.

Hollow Steel Bolts

Guest, Keen and Nettlefolds has been investigating the use of high tensile steels to produce hollow steel bolts; they are 10 to 20% lighter than standard bolts of the same size, but have similar strength and fatigue properties.

Doppler Order

During the Show it was announced that Air France had ordered Canadian Marconi ARINC version Doppler Sensor assemblies for its fleet of 17 Boeing 707-328s. The first delivery of this equipment will be made this month and the order completed by November.

Artist's Licence

A major conversation piece at the Show was the item of artistic symbolism at the hub of the B.A.C. stand. Various private explanations were to be heard. The official description is an "imaginative concept of modern aircraft shapes." Imaginative is the operative word.

Weather Radar

The duplicated E190 lightweight weather radar system specified for the VC10 was featured by Ekco Electronics. The equipment includes two transmitter/receiver units and two indicator/control units operating from a single scanner.

Versatile Starting

Vernons Industries featured a 30-kVA DC/AC mobile converter designed for the R.A.F. to enable the Service's standard DC starting trolley to be used with 400 c.p.s. supplied aircraft such as the Lightning. The company is also investigating possible applications for a similar converter trolley in the civil aircraft field.

Airborne Digital Computer

Decca were showing their new Omnitrack airborne digital computer which weighs only 40 lb. and occupies less than a cubic foot of space. It was developed initially, using an entirely new mathematical approach, for converting hyperbolic to rectangular co-ordinates so that normal map projections could be used in the Flight Log, but it has other useful airborne applications.

Gastronomical

New among the many G.E.C. aircraft galley items was a compact air-circulation oven holding six pre-cooked refrigerated meals. Ten of these 35-lb. ovens are on order for the R.C.A.F. for use in Grumman Albatross amphibians. Its not-so-compact designation is HE.48313 M1.

Instruments for B.E.A.

The Smiths 100,000-ft. servo altimeter has been selected by B.E.A. for retrospective fitment in its Comet, Viscount and Vanguard fleets. Exhibited on the Smiths Aviation Division stand, this instrument employs a single pointer which makes one revolution of the dial for each 1,000 ft. of altitude and digital counters that indicate to the nearest 50 ft.

Impact Recovery

On the Ministry of Aviation stand were components of magnetic tape recording equipment recovered from a Black Knight re-entry head fired in September, 1959. Magnetic tape was recovered in perfect condition within an armoured cassette.

Firestreak Carrier

A Missile Transporter Mk. 2 was exhibited by M. L. Aviation, Ltd. It is designed to carry four de Havilland Propellers Firestreak AAMs in low-loading cradles.

Unscreened Thunderbird

On the English Electric stand a Thunderbird was seen for the first time in cutaway form, showing the (simulated) radar head, radar electronics, telemetry equipment (for research and development rounds—measurement of *g*-forces, vibration, and guidance parameters, etc) and, behind the wings, the actuator pack for the steerable tail-vanes, and rocket tube.

Long-range Sender

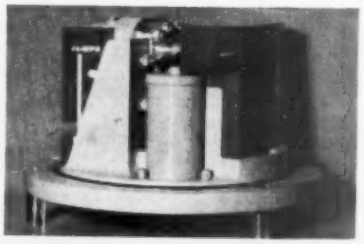
On the General Electric stand was a long-range telemetry sender for aircraft and missile applications. Based on the S.R.D.E. broadband telemetry system, this sender transmits seven channels, each of 3.5 kc/s bandwidth, together with a calibration and synchronized channel. Operating in the UHF band with an output of 80 W., a range of "several hundred miles" is obtainable.

Missile Computer

Shown by Sperry Gyroscope Co. was a small electronic computer for the Seaslug missile, which receives information from the guidance receiver and the various sensing devices and calculates the required angles for the control blades. It contains about 50 electronic valves and is fully sealed and pressurized. Valves are air-cooled without affecting pressurization.

Power Cut-off

A switch developed by Graviner uses four explosive cartridges to cut off the electrical supplies aboard a missile within 0.007 second.



Graviner's explosively operated switch.

VLF Navaid Research

The Comet 2E on show by the M.o.A. has been obtaining basic data on the problems of VLF radio propagation and ionosphere reflection characteristics. Phase 1 of the programme has involved about 100 hr. of flying over medium distances; Phase 2, to be started soon, will involve longer flights. The R.A.E. Radio Department hope that the work may lead to the development of an accurate and very reliable new navigation system for World-wide use.

Pressure Control

Speed and flexibility of response, and operational simplicity, are among the advantages of the Kelvin-Kollsman cabin-pressure control system which was shown for the first time and is illustrated on p. 424. It is to be installed in the D.H.121 Trident. The basis of the system is the use of an electrically actuated butterfly discharge valve which is regulated by means of amplified signals from three pressure-monitoring elements. An emergency trip-mechanism for the valve has its own separate actuator system.

Film Within Seconds

Kelvin Hughes' rapid processing photographic system, which can project a film of, say, a PPI display in from six to 30 seconds after exposure, has now been adapted for colour processing. At Farnborough this system was demonstrated publicly for the first time, using stills. This 16-mm. RP3 equipment can process special colour film in about 25 seconds.

Retort Courteous

An inquiry at the stand of a well-known equipment manufacturer, as to what they had that their competitor (equally well known and making almost identical equipment) did not have, elicited the quick reply "Experience."

Among new equipment produced by Graseby Instruments is a Universal Gyro Tester — the G.I.390 — for testing the gyroscopes used, for example, in inertial navigation systems.

Photograph copyright "The Aeroplane and Astronautics"

FOR ITS FUTURE DEVELOPMENT POSSIBILITIES...

The ENGLISH ELECTRIC Lightning is one of the most advanced fighters in the world. Even so the basic design has further great potential development—not only in performance, but also in adaptation to other operational roles. This built-in stretch offers economies of production and operation as well as ensuring that, tactically speaking, it can be adapted to meet any situation which may arise.

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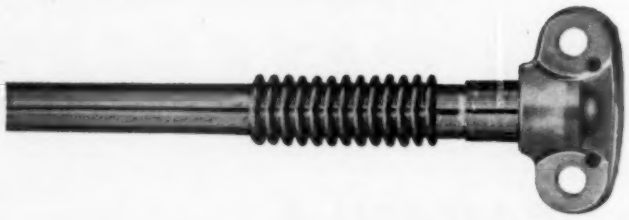
SILVOFLEX Palmer Silvoflex type 200 rubber hose continues to be specified by the leading manufacturers in the aircraft industry. These hoses have completed many millions of hours trouble free service.

FLUOROFLEX Palmer Fluoroflex (PTFE) flexible pipes are being employed on the most modern of today's aircraft and are also being increasingly specified for the aircraft of the future.

PALMAFLEX Palmaflex flexible metallic pipes are designed to handle hot gases and corrosive liquids under difficult conditions—and to pipe them through high temperature vibration zones. Palmaflex pipes are already proven on regular jet airline service throughout the world.



CORROFLEX Palmer Corroflex corrugated pipes facilitate the continued use of the most economical geometry associated with rigid pipes. Their unique design provides for compensation of variations in both temperature and vibration.

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Final Farnborough Report . . . .

Airborne Equipment Developments

STARTING from the front end of the aircraft, the first feature which could be much developed is the windscreen. Because of its position in the line of flight, things happen to the windscreen before they affect the rest of the aeroplane. There are, for example, birds, rain, ice and kinetic heat. Therefore, the new Triplex temperature resistant and curved windscreen with a silicone type K interlayer which will resist the effect of 150°C. is important. This is what future pilots will face. But more heat-resistant glass must follow. This has not yet been a major problem but it will be in the coming years of re-entry flight.

Ice is the next problem, as it has been since flight began, and the solution seems now to have settled down to a tapping of hot air from the engine compressors led through ducting to the leading-edges of the wings. This is done by the aircraft constructors themselves, but for the more remote parts of the structure the electric transmission of heat is now used.

Thus one finds the Napier Spraymat applied to the tail unit, the propeller blades and to helicopter rotors. Electrical de-icing is also applied to the windscreen through a transparent metallic layer on the surface. For small, lower speed aeroplanes, fluid de-icing—as shown by T.K.S.—is effective and their defrosting fluids are used before take-off.

From ice one turns to fire, and here the complete answer can be found in Graviner or Pyrene, with all their years of experience behind them. Both have everything and, therefore, they compete on price and weight in respect of a particular installation.

Smoke must be detected in a smouldering freight compartment at an incipient stage, and smoke detectors seem now to have a very quick answer. They talk of micro-seconds with micro percentages of smoke.

Fire detector strips or capillary tubes which can be threaded round potential fire zones were shown and they are capable of being reset and used again, should a fire revive or a new one start. The principles of these are old, and have been shown at previous Farnborough Shows. It is the rate of rise of temperature which is important and the ability to cope with this is a first concern.

The most distressing aircraft fires are those which occur in a crash, when possibly thousands of gallons of petroleum are let loose in pools all round the red hot fire sources of the engines. One was glad to find at Farnborough that the inertia type of fire switch is no longer demonstrated. This would often fail to detect the real cause of fire, yet give a false alarm when no fire was likely.

Pyrene's Impact Switch with its double safeguard is a great step forward, and Graviner has an electrical strip system which should respond to these disastrous occasions. But one still reads of crash fires and this subject still stirs the morbid imaginations of potential passengers, fed as they are by newspaper headlines of "dramatic" events.

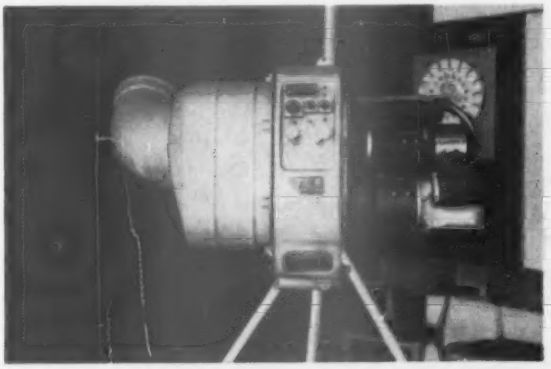
The economic pressure of speed, fuel economy, and low aerodynamic drag, combined with the development of pure jet engines have forced aircraft into the higher, low-pressure, regions which are only habitable if the cockpits and cabins are pressurized, humidified, sound-proofed, heated, cooled, and so forth. All this adds a great load to the tare weight and every pound (weight) added detracts many pounds (sterling) from the revenue. Normalair has shown a complete answer to this and have justified it economically, but one finds that the de Havilland Propeller Co. has entered into this field competitively.

Introduction of all this mechanical, electrical, pneumatic, and structural complication leads to the multiplied risk of failure of some minor detail. Therefore, we find that an emergency system is being introduced which must be immediately available to the crew and passengers if they are to survive, whilst the crippled aircraft drops or dives to a more naturally respirable climate. There is a technical argument as to whether the emergency oxygen should be stored under pressure or liquefied at a low temperature in vacuum bottles.

Liquid oxygen seems now to be preferred in the interests of weight saving. But whatever emergency system is used, it must be instantly available and at the moment when trouble occurs. The doctors say, so one is told, that everyone will be dead in three seconds after an explosive decompression. Is it yet possible to invigorate and save these people, old and young, within such a time? British Oxygen Aviation Services, Ltd., and Walter Kiddé are tackling this problem.

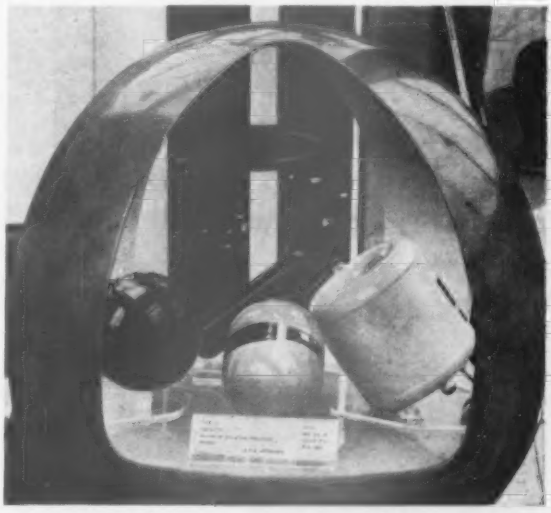
The storage of bottled gases, for these many purposes, leads to the development of new techniques in the deep drawing of tough steels, weldable or not, or of reinforced plastics. Chesterfield is a traditional name in this field, but in recent years one finds Bristol Aerojet entering it competitively. Both exhibited their latest products on their own stands at Farnborough or on those of Pyrene, Graviner and British Oxygen. Bristol Aerojet is in most minds associated with the storage and use of missile fuels but we will hear more of them in the pressure bottle field.

Mallinsons demonstrated a flooring material which is now



This compact aircraft auxiliary power unit was displayed by the Rover company and is intended for the Vulcan.

British Oxygen were showing a new miniature expansion turbine, less than 3 in. long, which has a potential use as a cold air unit for aircraft cabin air-conditioning systems.



For various airframe systems applications, there is a growing interest in lightweight pressure bottles capable of withstanding very high pressures. This display was on the Bristol Aerojet stand.

A neat inertia lock for pilots' shoulder harness has been developed by Teleflex. The lock is contained in the small cylinder at the base of the seat back.

used in the new generation of airliners. This consists of a balsa interlayer sandwiched between aluminium-alloy sheets. The worst trouble which this light but robust material can meet appears to be that of the weight of one female passenger balancing on a single stiletto heel. Statistically this may amount to a quarter of a ton per square inch, but if she stamps her foot impatiently the stress is multiplied by as many *g* as her temper. This then becomes a serious replacement matter of either floor, or girl friend, or both.

I tried at Farnborough to track down the truth of the so-called fireproof hydraulic fluids. Water was, of course, the original hydraulic fluid studied by Archimedes and his successors. At some stage in history the oil people got cracking, if that is the right phrase, and their claims to low viscosity and small variations within the range of operating temperatures led to the general use of petroleum fluids. These are inevitably inflammable and many fires have been traced to this material.

There are now two non-inflammable fluids on the market but I could find out very little about them at Farnborough. Apparently both are criticized for adverse features and they have the chemists worried in providing new sealant materials and paint finishes which will resist them. I discussed this with representatives of Dowty, Lockheed, Dunlop, Cellon, Titanine and I.C.I. They seemed confident that the new fluids can now be used without fear, but they cannot be put straight into existing hydraulic systems, without changing the seals or paint finishes in the neighbourhood of joints. Recent French research carried out and reported on by O.N.E.R.A. suggests that the ideal hydraulic fluid has not been perfected.

Passenger seats for use in aircraft call for a high standard of engineering and I therefore looked with interest at the latest products of Microcell, Aircraft Furnishings, and Lancefield. But a pilot's seat in a military aircraft has a much more exacting specification. One detail which has cost many hours of development is the inertia lock for the shoulder harness which will allow the pilot freedom of movement, but which will lock fast under a sudden impact load and prevent him being flung forward against his controls and dashboard. Teleflex has solved this problem and showed an inertia lock on the back of the pilot's seat, which releases under a gentle load, then winds back, but which goes solid if a sudden demand is made on it.

New versions of Fireproof Tanks' flexible containers for drinking water and fuel have been developed.

Localized hot and cold spots or circuits in the aircraft call for treatment. Sir George Godfrey and Partners has a vapour cycle cooling package. This incorporates all the components of a complete vapour cycle refrigeration system with the exception of the condenser, which may be remotely installed.

Heat generated in the aircraft equipment is given up to a water/glycol coolant circulated through the evaporator of the package. The heat is there transferred from the coolant to the refrigerant and is finally rejected to a cooling flow of ram air through the condenser. The compressor is driven by an 8 h.p. AC motor.

Apart from their range of blowers and compressors, Plannair were showing a small portable 6-kW. cabin-heating unit. Operating on 24V. DC, it can be supplied directly from an aircraft's electrical system.

British Oxygen has developed a new miniature expansion turbine less than three inches long which can produce cold air for cabin air conditioning systems. High rotational speeds are achieved at low weight and high efficiency by means of air lubricated bearings, without the risk of contaminating the air with oil or other lubricant.

The company has also pursued the question of explosion suppression in fuel tanks by means of inert gas, nitrogen. This system, first introduced into bombers during the War, has now been developed to protect the tanks of high speed long range civil transports where kinetic heating and big atmospheric changes might cause rapid evaporation of the fuel and form explosive mixtures in the tanks.

The Kelvin-Kollsman cabin pressure control system components on the company's stand.

Particular spots where cooling is required have always been in the wheel braking systems where the friction generated heat has to be dispersed. Dunlop was showing an air-cooled brake with an electrically driven fan built into the wheel hub.

As part of the family of systems for aircraft, the use of electricity is still developing, with ever increasing power being demanded. In the main, this is being generated as AC; in some cases this is converted to DC by static means, and in others is used as raw AC.

It is interesting to note the marriage of various systems in the development of constant-speed drive units, e.g., drives are utilizing pneumatic power (Rotax) or hydraulic (Hobsons, English Electric) or mixtures (Plessey). These methods appear to give new life to the efforts to produce efficient and light weight electric power.

Dowty has a ram-air turbine which provides a completely independent power source with ease of installation, mechanical reliability, minimum maintenance, automatic controlled variable-pitch turbine blades, wide operating ambient air temperatures range, de-icing protection, and so forth. The turbine is a single-stage axial-flow type having two or more turbine blades, according to operating requirements. The blades have automatic variable-pitch control from a built-in speed sensitive governor system.

Chemists are playing an ever greater part in aircraft manufacture especially in the field of flexible materials which are resistant to a wide range of temperatures and attack from fuels and the like. Fireproof Tanks has always been in the forefront of this field since the company first introduced flexible bag tanks for petrol before the War. On show was a wide range of applications for these materials including Jerry bags for fuel, and others which are suitable for drinking water without any risk of contamination. These can be repeatedly steam sterilized.

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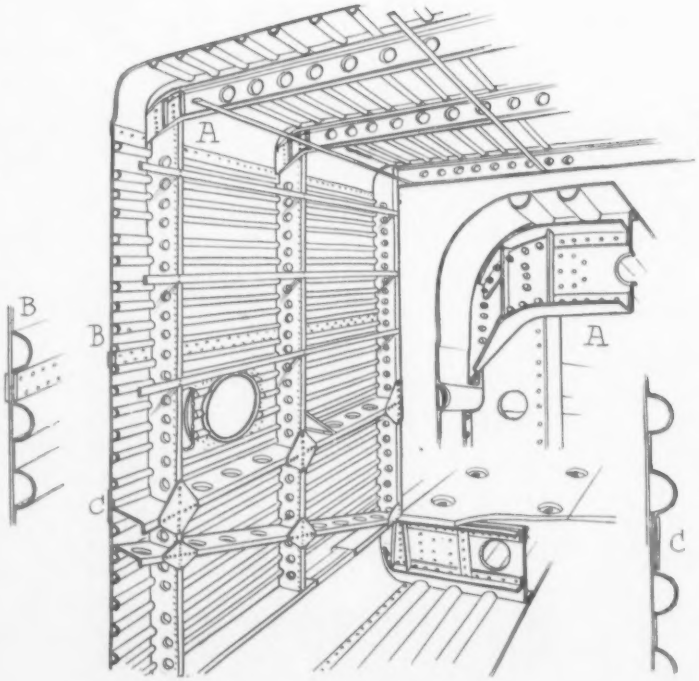
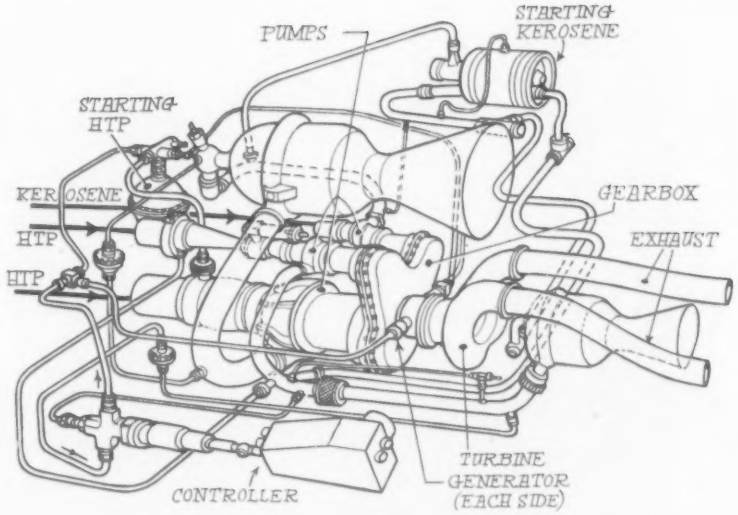
From J. H. CLARK'S Notebook



Left, structural details gleaned from the cutaway exhibit of the SC.7 Skyvan on the Short stand.

Right, diagrammatic layout of Stentor of which complete installation is shown bottom left. The engine has a large fixed-thrust chamber and small variable-thrust one.



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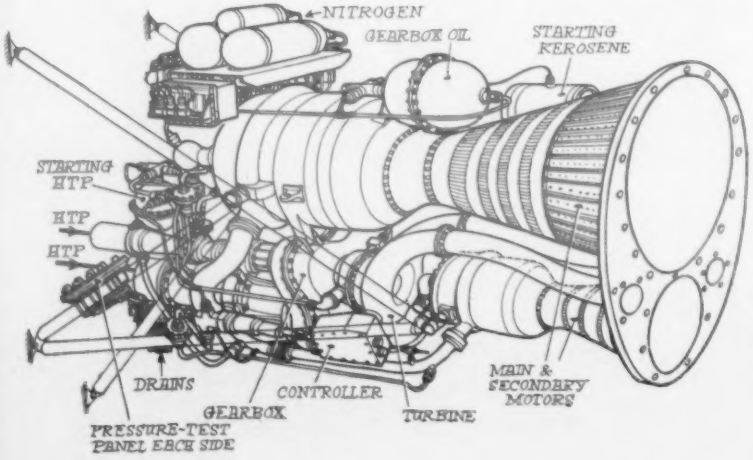
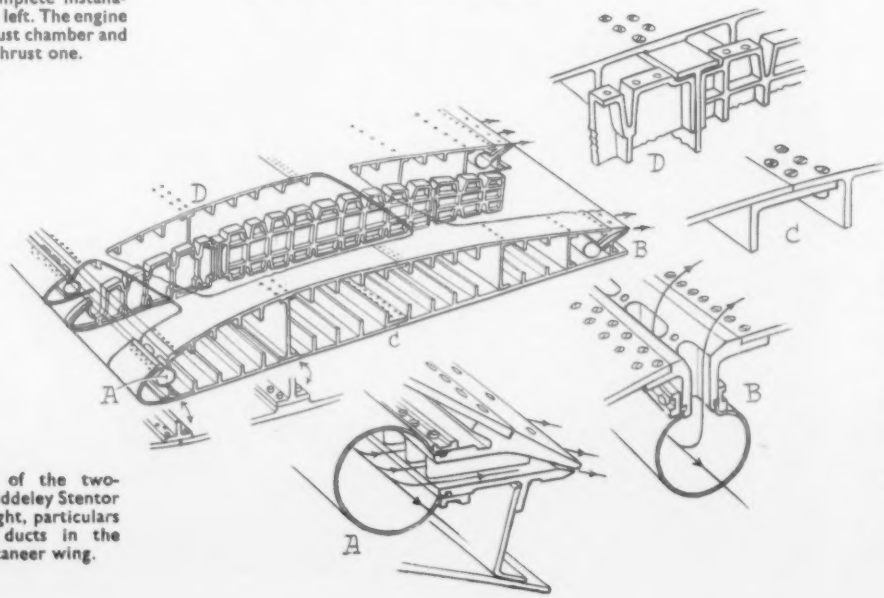
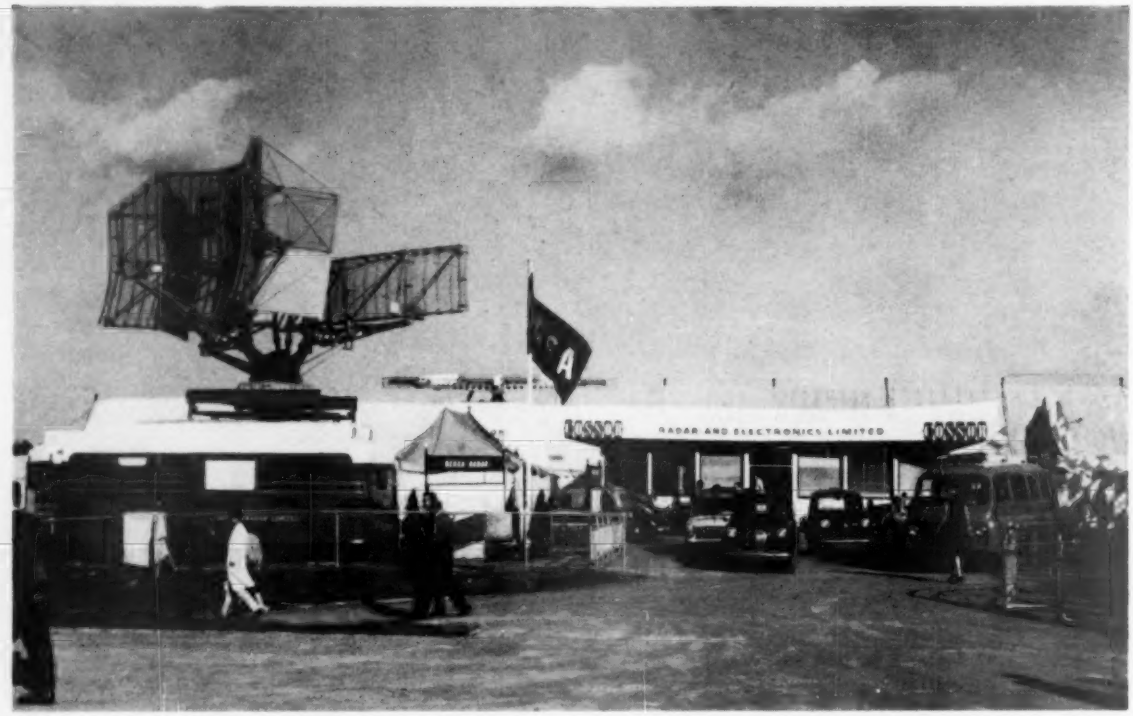


Left, installation of the two-chamber Bristol Siddeley Stentor rocket motor. Right, particulars of the blowing ducts in the Blackburn Buccaneer wing.





A.T.C. Developments

ALTHOUGH there were no full-scale exhibits at Farnborough which specifically demonstrated next-generation A.T.C. concepts, there were a large number of items which together formed steps towards new thinking and techniques. These ranged from an illustration of the Ferranti Apollo A.T.C. computer to the demonstration of new radar techniques and of developed methods of procedural control and guidance.

The Ministry of Aviation, on its outdoor stand and radar site displays, tried hard and successfully to show some of the present techniques and the detailed way in which these techniques are being developed year by year. On the radar site the Ministry provides active simulated demonstrations of GCA—or Precision Approach Radar (PAR) as it is now known. There the onlooker could see and hear how a talk-down is done, using a 3-cm. radar which, designed and assembled by Ministry staff, is now in operation at London Airport.

The displays are now in the tower, where the talk-down is conducted. Glide-path and tracking information is provided on a single duplicated display and certain of the patterns and the measuring data are optically projected on to the tubes. Standards of pattern and echo accuracy are maintained by means of permanent marker reflectors located at critical points on the approach path. On its outdoor stand the Ministry was showing examples of standard control desks and equipment.

Ferranti's Apollo computer will be going into experimental operation for the Ministry at Redbrae, Prestwick, early next year. It will work in parallel with the normal oceanic A.T.C. system and will "file" flight-progress information for up to 100 aircraft, identify traffic conflicts, and automatically print out progress strips.

Recording "Raw" Radar

Decca were using their radar tape recorder—which plays back "raw" radar and R/T, or other speech, on the sound track—to demonstrate the actual performance of their DASR-1 surveillance radar at the new Arlanda Airport, Stockholm. The recording was made in fairly poor weather conditions with areas of heavy rain, and the effects of the use of circular polarization and air target indication on both rain and ground clutter were demonstrated in actual operating conditions.

The R/T sound track directed attention to the return from a DC-8 which was returning to Arlanda with engine trouble, and the recording showed how this return could be lost in clutter and immediately picked up again when the unwanted returns were removed. The demonstration was given on the two displays which would normally be used with the system—one set for local (30-mile), and the other for area, coverage. The recorder has obvious applications in radar training and A.T.C. research.

TV in A.T.C.

Television was shown in two applications for A.T.C. work. Standard Telephones were demonstrating their new PVT-2 automatic D/F triangulation aircraft-position finder, using normal R/T transmissions, which employs closed-circuit television to provide two or more displays or monitors. The bearing indications on the displays are combined optically with elements of an illuminated map. The system is a development of the PVT-1. At the display the equipment was being fed with signals from CADF at Bovingdon and from the outside site at Farnborough where Airtech were exhibiting CADF equipment.

Pye exhibited a radio-directed television camera for airfield use. The camera is moved by joystick from the control point through a 450 Mc/s UHF system and the pictures are transmitted back to the display from the camera by a microwave link. The camera is thus independent of cables and is transportable.

Marconi's were showing closed-circuit displays both for their visual information system and for "seeing round corners" on apron control and other similar duties. In the former the data which have to be disseminated are marked on the edge-lit transparent writing surface of the V.I. unit desk and the information is repeated on screens elsewhere. A more elaborate system, including colour, is under construction for the Royal Swedish Air Board.

For the radar specialists the Marconi parametric amplifier would have been of interest. This promises to increase the range coverage of 50-cm. radar by 25% through a reduction in signal/noise ratio.

Meteorological Radar

Cossor's CR.353 wind-finding S-band radar equipment was shown with the basic control unit by which the passive reflector, carried by the balloon, is followed by means of cross-pointer display on a panel which carries dials showing the co-ordinates of the target. A timing mechanism freezes the indicators at regular intervals so that the results can be plotted. Optional extras to the equipment include automatic recording of the data; a computer to convert elevation and slant range into altitude and ground range; a teleprinter relay transmitter; and a PPI display.—H.A.T.

Final Farnborough Report . . . .

Airborne Electronics

PROMINENT among the new developments in airborne communication and navigation equipment exhibited for the first time at the show was the Marconi "Sixty Series." Fully transistorized, with the exception of the VHF transmitter output stage, the series comprises the Type AD 160 VHF communication equipment; Type AD 260 navigation and approach guidance system; automatic direction finder Type AD 360; Type 4637 radio magnetic indicator; and the AD 308 radio teleprinter receiver.

The VHF transmitter 6400 provides 360 crystal-controlled channels between 118.0 Mc/s. and 135.95 Mc/s. at 50 kc/s. spacing. It weighs 14 lb. and is housed in a short ½ ATR case. In addition to meeting the requirements of ARINC characteristic 520A, the transmitter incorporates Marconi automatic modulation control and speech clipping. It can be used with either electro-magnetic microphones, including noise-cancelling types, or carbon microphones.

The receiver for the Sixty Series transmitter and navigational units is the 6401. Providing 560 channels in the 108 to 135.95 Mc/s. band, it weighs 9 lb. and is housed in a short ½ ATR case.

Full instrumentation VOR and ILS outputs for feeding standard deviation indicators, flight directors or RMIs are provided by the 6402 navigation unit in conjunction with the 6401 receiver. An improved form of flag-warning system indicates VOR servo-operation failure, or loss of the 400 c.p.s. power, as well as loss of any of the tone signals used for localizer and VOR operation. Both aural and visual (three lamps) indications of ILS and airways beacons are provided by the 6403 marker receiver. All three units making up the AD 260 use the sealed module principle of construction.

The AD 360 ADF is the most recent development in the Marconi range of fixed loop direction finders and retains the principal features of the AD 712 equipment. It weighs 18½ lb., is housed in a short ½ ATR case and can be used with the new 4637 RMI. This latter unit is a twin-needle instrument incorporating transistorized servo amplifiers.

Already in production and ordered by B.O.A.C. for its Boeing 707 fleet, the AD 308 radio teleprinter receiver is fully transistorized and is contained in a short ½ ATR case. It receives narrow-band telegraph signals on any of the four spot frequencies in the 90-150 kc/s. range.

Two other major ranges of airborne communication and navigation equipment which are in production in this country were on display. One is the 21 Series manufactured by Elliott Brothers (London), Ltd., under licence from the Bendix Corporation, and the other is the Standard Telephones and Cables STR 23/34/35/36 equipment. Both installations provide VHF communication/ILS/VOR facilities and are intended primarily for airline use.

Ultra Electronics demonstrated their communication control selection system which comprises a basic station incorporating 15 push buttons for the selection of communication facilities. Specified in various forms for such types as the VC 10, Avro 748 and Westland Wasp helicopter, the system includes associated items such as junction boxes, ground-crew intercommunication connections and stewards' station boxes.

Developments in the display of navigational information at the show included the Decca-ARINC presentation of Doppler indications. The company's new range to meet these specifications comprises a groundspeed and drift indicator employing a digital groundspeed counter and dial drift presentation; a control unit containing "inching," on/off/standby and land/sea controls; and a computer control unit for setting up two independent required tracks. The Flight Log inching control enables a pictorial display to be added to the normal instrument presentation.

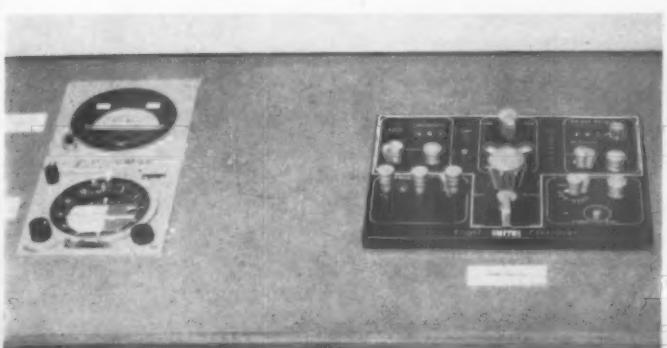
Autopilots and Automatic Landing

Following the first public showing of the BLEU automatic landing system at the last S.B.A.C. exhibition, one of the most interesting instrumentation displays this year was on the SEP.5 autopilot system developed by Smiths Aviation Division. Consisting of the pilot control unit, attitude director and flight compass below an illustration of the mock-up cockpit for the D.H.121 Trident, the exhibit helped to outline the company's work in this field.

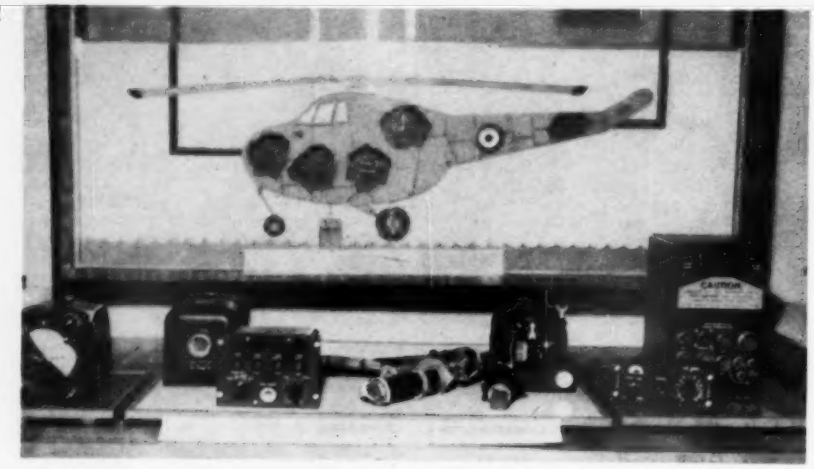
The SEP.5 autopilot has been developed since 1955 as a replacement for the earlier SEP.2 system and its military development—the SEP.4. Designed from the start for automatic landing requirements, it incorporates the Smiths multiplex philosophy for providing the necessary reliability and safety

The new Decca Doppler instruments for meeting ARINC specifications. From left to right are the main control unit, which includes Flight Log pictorial display "inching" controls; the groundspeed and drift meter; and the computer control panel.

Below is part of the Smiths Aviation Division display containing the flight controller, attitude director and flight compass for the SEP.5 autopilot system. The layout of the various selectors on the controller conforms to the basic "T" of blind flying instrumentation.



Two units from the new Marconi "Sixty Series" airborne communication and navigation equipment. Transistorization and sealed module construction play an important part in the design of this system.



On the Louis Newmark stand was this display of helicopter autopilot components. The company is manufacturing autopilot/stabilizer systems, including transistorized equipment, for a number of helicopter types.

factors in practical civil operations. In the Tridents for B.E.A. it is to be installed, in the first instance, in duplex form to provide automatic flare-out capability; later it can be brought up to triplex level for fully automatic landings.

In addition, a military installation of the SEP.5 in triplex form is to be fitted in the R.A.F. Transport Command Britannics for providing fully automatic landing facilities from the outset. The B.E.A. Tridents are expected in service in 1962; Transport Command is hoping to receive its first Britannics in 1964. A realistic date for full civil Autoland is thought to be 1968, although the practical civil application of the system is believed from the purely technical state of the art to be possible at an earlier date.

A multiplex SEP.5 autopilot has now been flying in the Smiths Dakota for more than two years. A total of over 4,000 automatic landings have been completed by the company and BLEU at Bedford with the single-channel system adopted by R.A.F. Bomber Command for its V-bombers.

In layout, the SEP.5 controller conforms to the basic "T" of general blind-flying instrumentation. The top left-hand side contains the speed lock and trimmer in place of the airspeed indicator; the central artificial horizon has been replaced by glide and azimuth controls; and in the top right-hand corner is the altitude lock representing the altimeter. Below, the compass has been replaced by the bank, or change of heading, controller, with the autopilot master controls on its left, and the descent lock, replacing the V.S.I., in the lower right-hand corner.

Helicopter autopilot systems were also featured at the Show. Louis Newmark exhibited for the first time a three-axis autopilot/stabilizer for lightweight helicopters such as the Skeeter. As well as providing basic stability, this unit is capable of providing manœuvre, heading and height control facilities. A development of the company's earlier equipment —the X-27—it employs transistorized servo amplifiers and is at present undergoing a flight trials programme.

For the larger helicopter there was the Mk. 19 Newmark autopilot developed from Lear equipment. This system, with auxiliary components, can provide navigation facilities as well as stability in both flight and hover.

Fire Control Systems

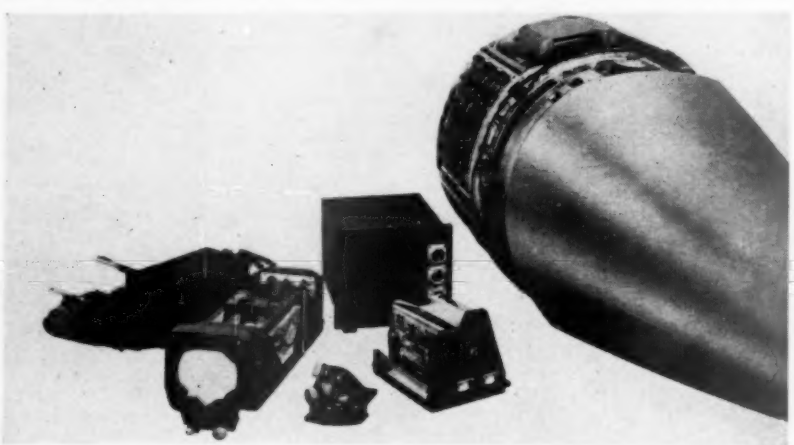
Exhibits featuring weapon fire-control equipment for military aircraft included the Ferranti integrated strike and interceptor system (I.S.I.S.) and Airpass Mk. 2.

Designed for ground-support aircraft, such as the Fiat G.91 or Folland Gnat, the I.S.I.S. family of light fighter fire-control systems has also been adopted as stand-by weapon sights for the more complicated Service all-weather fighters. At present four variants of the system, built up from seven basic units, provide air-to-air, air-to-ground and R/P, and dive-bombing facilities. In addition, air-to-air missile launching can be accommodated in the more advanced versions of the equipment.

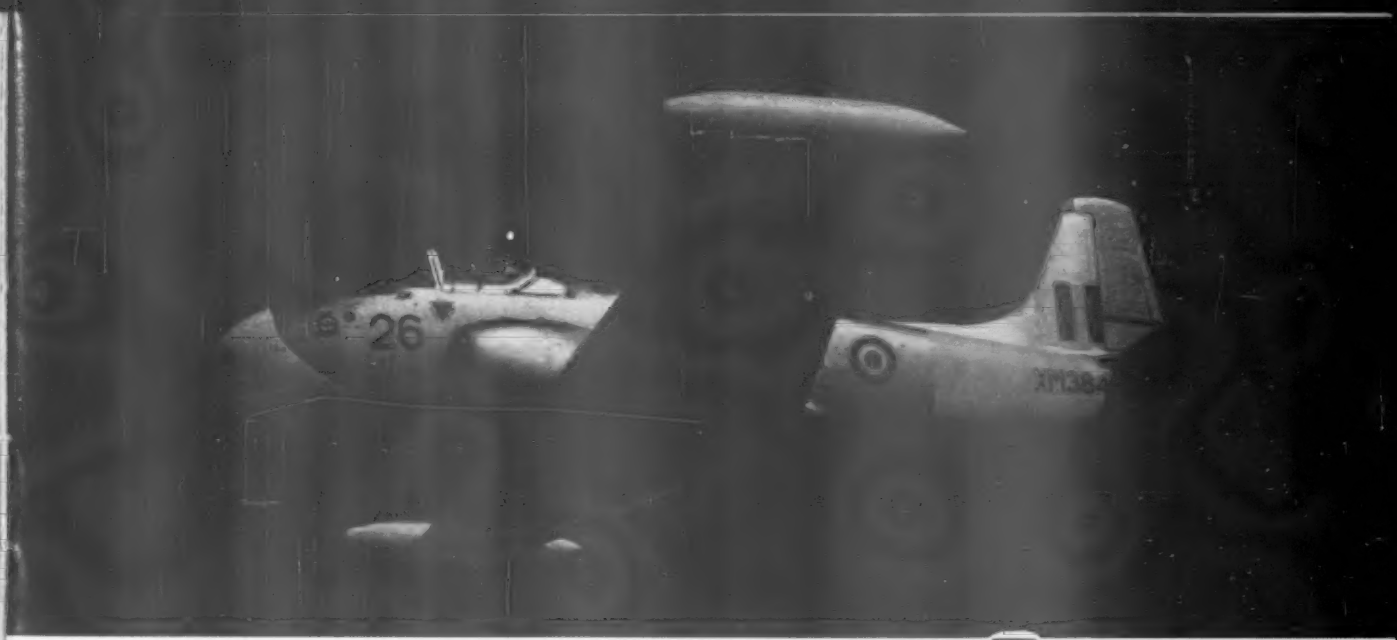
The system is independent of any ranging radar and employs optical ranging for gun and rocket attacks and kinematic ranging for bombing. This is based on the measurement of the rate of turn of the aircraft in space by a two-axis rate gyro.

Two sighting heads, a light fighter sight (L.F.S.) or a light director sight (L.D.S.) can be employed with I.S.I.S. The L.F.S. is a small gyro-gunsight with a moving aiming mark but no fixed graticule. The L.D.S. can display simultaneously a fixed and a moving graticule in collimated form so that they appear superimposed in front of the pilot's windscreen. When used for conventional weapon-aiming the fixed pattern in the L.D.S. is removed, but in the director rôle (i.e., in nuclear bombing or navigation presentation), the moving pattern changes to a dot which the pilot "tracks" with the fixed aiming mark.

Airpass Mk. 2, developed by Ferranti as a private venture from the Mk. 1 interception radar and pilot-attack sight system for the English Electric Lightning, is designed to meet the European requirement for dual-purpose interceptor/strike aircraft such as the Saab Draken or Dassault Mirage III. In addition to the high-level interception facilities of Airpass Mk. 1, this new system can be employed in air-to-ground weapon-aiming, in the low-level navigation rôle, for contour mapping requirements and for terrain clearance or profile flying.—P.R.R.



The radar unit, hand controller, search display, pilot attack sight and some of the other components of Ferranti Airpass Mk. 2. A bombing or navigation computer can also be added to some versions of the equipment.



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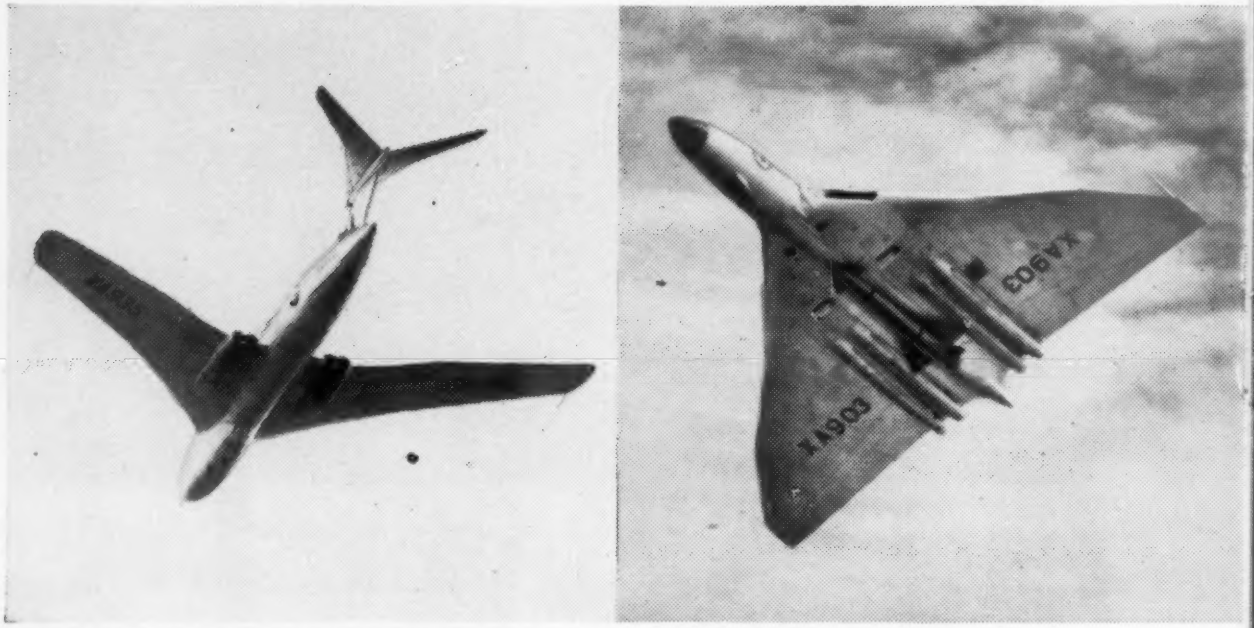
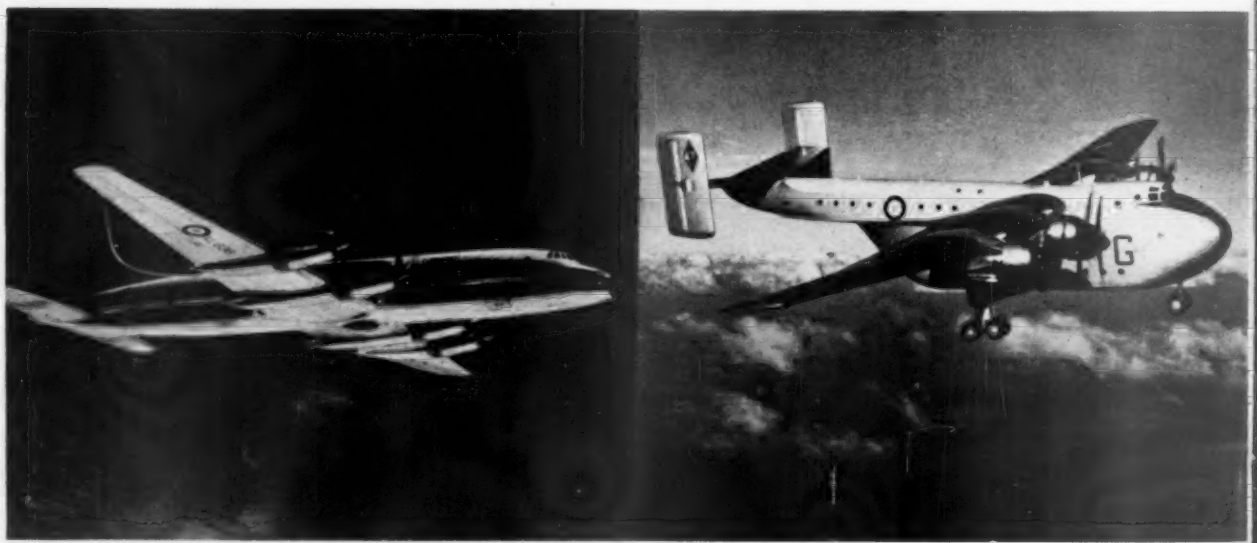


RAF deterrent force relies on the most advanced aircraft and missiles . . .



RAF Transport Command provides 5,000-mile range—20-ton payload capacity . . .

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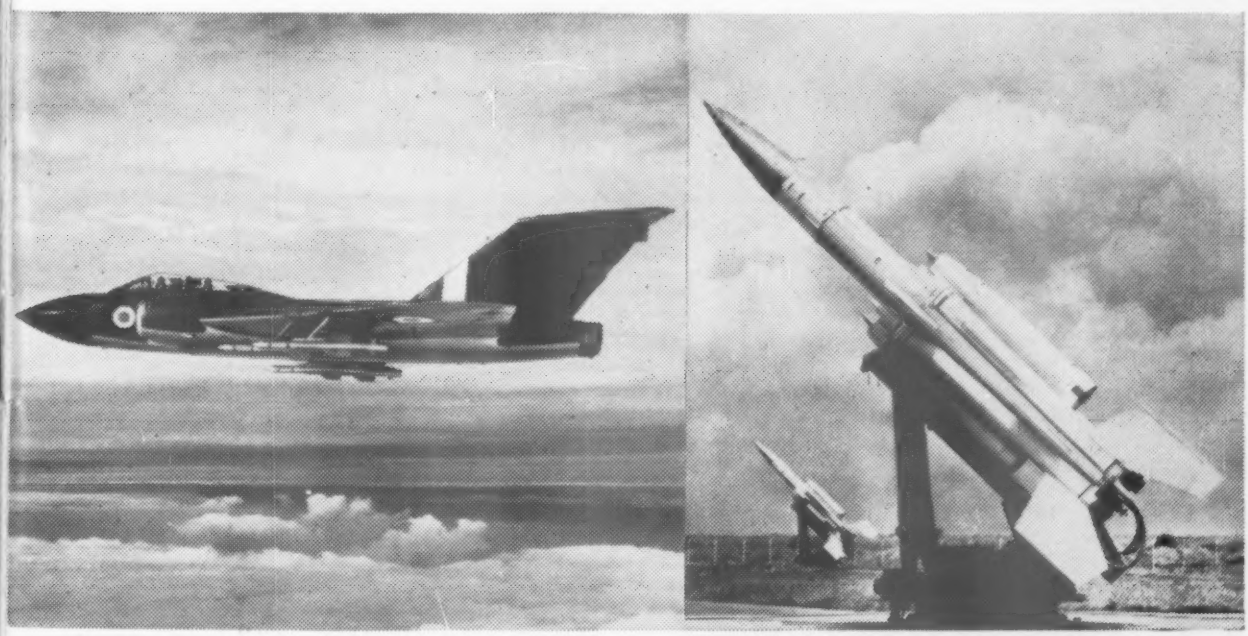
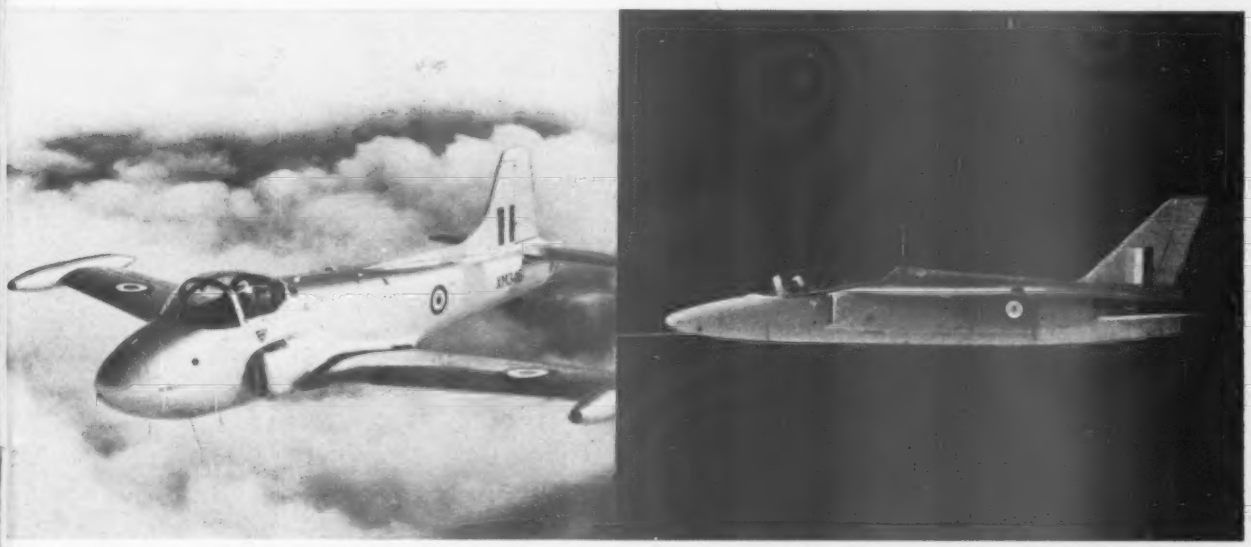


RAF round-the-clock defence intercepts aircraft hundreds of miles out, far up into the stratosphere . . .



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Final Farnborough Report . . . .

Materials and Processes

ADVANCES in aeronautical and production processes rarely come as spectacular leaps forward. They are usually introduced gradually as the result of progressive behind-the-scenes development over the years. Farnborough this year gave many examples of the steady rate of progress which is being maintained.

Typical is the demand for ever larger and more accurate forgings in ever-stronger materials; there is a similar trend in the demand for, and the use of, castings. High Duty Alloys, to take one example, showed large steel forgings for the Blackburn Buccaneer and de Havilland Trident; they also exhibited a draftless forged seat support of excellent finish and accuracy.

An interesting exhibit in the casting line was shown on the Napier stand, where a range of high-accuracy investment castings were exhibited. There was also a comparison between components produced by investment casting and by other techniques, indicating the saving in production costs.

A wider use of integral construction is evident. Morfax, Ltd., exhibited some large airframe components routed from the solid. Considerable use of machining from the solid is made in the structure of the Blackburn Buccaneer and Vickers Vanguard, to quote only two examples.

New developments in both materials and production techniques for turbojet engines were on view. The Nimonic range of alloys produced by Henry Wiggin is being extended regularly. This year was no exception; a new sheet alloy was revealed with properties between those of Nimonic 75 and 80A. Advances have also been made in the size of Nimonic 90 billets which can be produced. They have increased in weight from 150 to 600 lb. over the past year. Firth-Derihon exhibited a forged turbine disc in this material; it weighed 468 lb. The billet weight was 525 lb.

The production of vacuum-melted metal alloys appears to be growing. Firth-Derihon, for example, exhibited forged engine discs of vacuum-melted steel; these are now being produced in quantity.

Other materials to show advances include glass-fibre plastics and new metals. I.C.I. showed the forward-looking nature of its activities by mentioning its commercial production of zirconium and stating that it is now producing 7 tons a year of beryllium.

As with materials, production processes advance gradually. Bristol Aerojet showed interesting examples of two techniques which it is studying; the production of helically welded steel tubes for rocket-motor cases, and chemical milling, which is also used by several aircraft companies. Argonarc spot-welding was exhibited by British Oxygen; it is of increasing interest to the aircraft industry as steel structures become more common.

Details are given below of several interesting materials and production techniques which were exhibited.

Argonarc Spot-welding

Although the Argonarc spot-welding process is of particular interest for its application to stainless steel structures such as those of the Bristol 188 and Blue Streak LRBM, the latest development work by British Oxygen Gases, Ltd., has indicated that for some applications it can be used on commercially pure aluminium and some aluminium alloys. At present it is applied to the welding of mild steels, alloy steels and titanium.

The Argonarc spot-welding torch is portable, simple to operate and allows welds to be made when access is only available to one side of the joint. An argon-shielded tungsten arc is used as the heat source; heat is transferred across the joint interface, melting the mating surfaces to form a localized area of sound fused metal.

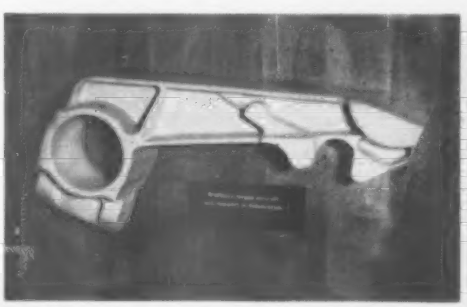
To ensure a high-quality weld the current cycle is controlled by an electronic timer which operates a current decay system. The cooling rate of the molten metal is controlled in this way to give high-quality results. Welds are free from craters and associated defects. The entire welding cycle varies between 1½ and 3½ sec. per spot-weld. Interchangeable nozzles allow the torch to be used for making spot-welds in difficult positions.

With welds in stainless steel the average failing load per spot varies from 440 lb. for 24 s.w.g. sheet to 1,930 lb. for 16 s.w.g. sheet. Failing loads per spot for S.3 mild steel range from 879 lb. for 20 s.w.g. sheet to 1,278 lb. for 16 s.w.g. sheet.

Wound Fibreglass Structures

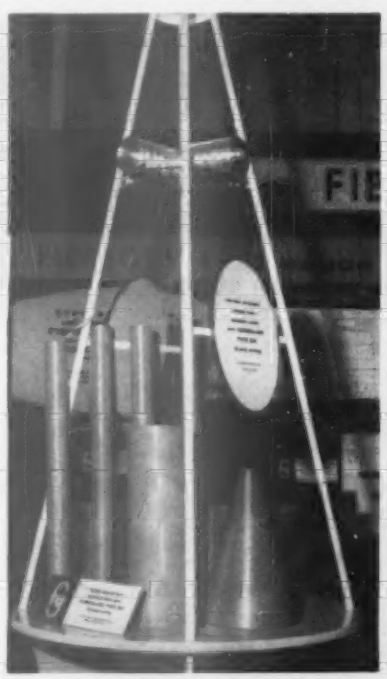
A new development in reinforced plastics is exhibited by Fibreglass, Ltd. It is a new sizing which is applied to their continuous-filament E glass to give a very efficient reinforcement for epoxide and phenolic resins. The glass filament treated with this sizing will be marketed as Type 301 roving.

This will increase the strength of rocket-motor casings and conical radomes which are wound direct from glass filaments. It also gives a very much better resistance to atmospheric



Right, this draftless forged aircraft seat support was produced in Hiduminium by High Duty Alloys.

Left, turbine/aft-fan blades—known as bluckets—for the General Electric CJ 805 turbofan are produced in Britain by Firth-Derihon, Ltd. and Centrax, Ltd. using M.252 nickel-based alloy supplied from the U.S.



Right, improvements in the strength and climatic resistance of wound glass-fibre rocket-motor cases and radomes are promised by the new Type 301 12-end Fibreglass roving.

deterioration than the material it replaces. Fibreglass exhibited a range of tubes and a radome made from the Type 301 roving; they had been lent by the R.A.E., Bristol Aerojet and English Electric.

Rods made up of longitudinal filaments of Type 301 have been tested, and compared with rods of the earlier VE product. They show that the dry ultimate flexural strength has gone up to 197,000 lb./sq. in. from 145,000 lb./sq. in. There is an even more impressive improvement in the strength after a three-day boil (reckoned to be equivalent to severe exposure to tropical conditions); in this case the flexural strength has risen from 50,550 to 129,000 lb./sq. in.

Erosion-resistant Materials

Rain erosion of radomes and other forward-facing surfaces on high-speed aircraft and missiles creates severe problems. An interesting exhibit on the Ministry of Aviation stand showed some of the work which is being done in this field and the types of material which are most promising for future applications.

At the R.A.E., a whirling arm rig is used to simulate rain-erosion effects on small specimens at speeds up to 500 m.p.h. Tests can also be made at Pendine where a rocket-driven sled can be sent at supersonic speed through 500 ft. of artificial rain; this facility has the disadvantage that it exposes specimens to simulated rain for only a very short period of time.

In the Farnborough tests the specimens are subjected to a simulated rainfall of one inch per hour at a speed of 500 m.p.h. The tests last for several hours. The new generation of high-speed low-level strike aircraft is likely to be exposed to more exacting conditions than these, but the rain-erosion tests have been based on radar limitations.

The attenuation of X-band radar under the test rainfall would probably be so great as to prevent a strike aircraft from operating effectively. In this case it might have to reduce speed or turn back.

Tests showed that some materials are very susceptible to rain erosion; Perspex specimens, for example, were severely eroded after 20 min. exposure to the test conditions. Moulded nylon was exposed to the simulated rain for 18 hr. before it was damaged to the same extent. The only materials which were virtually undamaged after some 30 hr. testing were stainless steel and the Sintox ceramic produced by Lodge Plugs, Ltd. A wide range of plastics, ceramics and metals was tested. Micrograin nickel proved very effective as a protection sheath.

It was found that a 0.015-in. coating of neoprene or polyurethane greatly extended the life of otherwise unprotected glass-fibre radomes. The tests also showed that by measuring the loss of weight of specimens the erosion effects of speed and rainfall rate could be assessed.

Below a critical speed (208 m.p.h. for Perspex) there is no erosion. This speed varies for each material; above it the erosion rate is directly proportional to the rainfall and to the third or fourth power of the increase of velocity above this critical value.

The practical result of this is that erosion can be very greatly reduced by sloping the surface to reduce impact velocity at 90° to the surface; this effect was illustrated by a range of Perspex specimens exhibited on the M.o.A. stand.

Protection of radomes is a difficult problem because coatings affect their dielectric constant. Current coatings are also temperature limited. The ultimate answer for missiles and supersonic aircraft appears to be the use of ceramics or a material such as Pyroceram 9606. This is an internally nucleated glass from which radomes can be produced by glass-making techniques. After this they are heat-treated so that the material becomes in effect a ceramic. This material has been developed in the U.S. and is used for radomes of the Terrier and Tartar missiles.

New Airframe Fastener

Increasing use of Huckbolt fasteners is being made in the construction of new British aircraft such as the Avro 748, de Havilland Trident, Hawker P.1127 and Short Britannic. These fasteners are produced in Britain by Aviation Developments, Ltd., under an arrangement with the Huck Manufacturing Co. of Detroit. They are widely used in the U.S. and it has been stated that the Douglas DC-8 has as many Huckbolts as rivets.

These fasteners are driven with a high-speed pneumatic hand tool; a test has shown that it takes four hours to drive 1,000 Huckbolts. For 1,000 comparable nuts and bolts the time is reckoned to be 20 hr., even when a nut-runner is used. It is, in fact, claimed that Huckbolts are both cheaper and lighter than nuts and bolts.

Aviation Developments are producing $\frac{3}{16}$- and $\frac{1}{4}$-inch Huckbolts in both steel and light alloy. The light-alloy fasteners are available with pan-heads only, but the steel ones can be supplied either with pan or countersunk heads. Larger sizes can be supplied from the U.S. Information about these fasteners was given in our issue of Mar. 4.—J.R.C.

Passenger Services

FURTHER developments were to be seen in the provision of emergency oxygen supply systems for civil transport aircraft to meet next year's revised Air Navigation Directions. The trend, as seen last year, is towards the use of liquid oxygen and converters.

The Vickers VC10 may well be the first civil transport aircraft to have an integrally developed liquid oxygen system. Normalair were showing a VC10 converter unit as part of the system which they are supplying in co-operation with Walter Kidde, who are working on the associated passenger/crew equipment. This converter has a capacity of 30 litres, and a feature of the system is the flight-crew reserve circuit which automatically guarantees a supply regardless of passenger consumption.

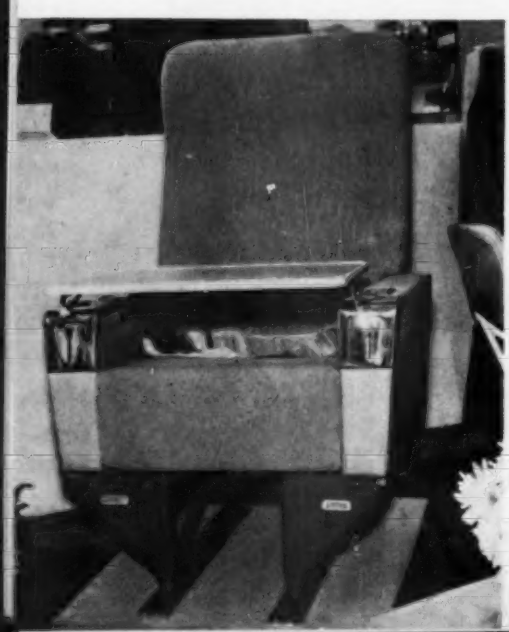
Apart from wide general work on oxygen—and particularly on liquid oxygen and associated converters and equipment—British Oxygen Aviation Services are now offering a breathing system to suit the requirements of private and executive aircraft owners. This is portable and does not form an integral part of the aircraft, so there are no airworthiness problems. Duration is approximately 2½ hr. for four persons when cruising at 15,000 ft.

Walter Kidde, who work in association with British Oxygen and Normalair, were showing a new emergency oxygen control and equipment panel for use by transport flight crews.

Executive Comfort

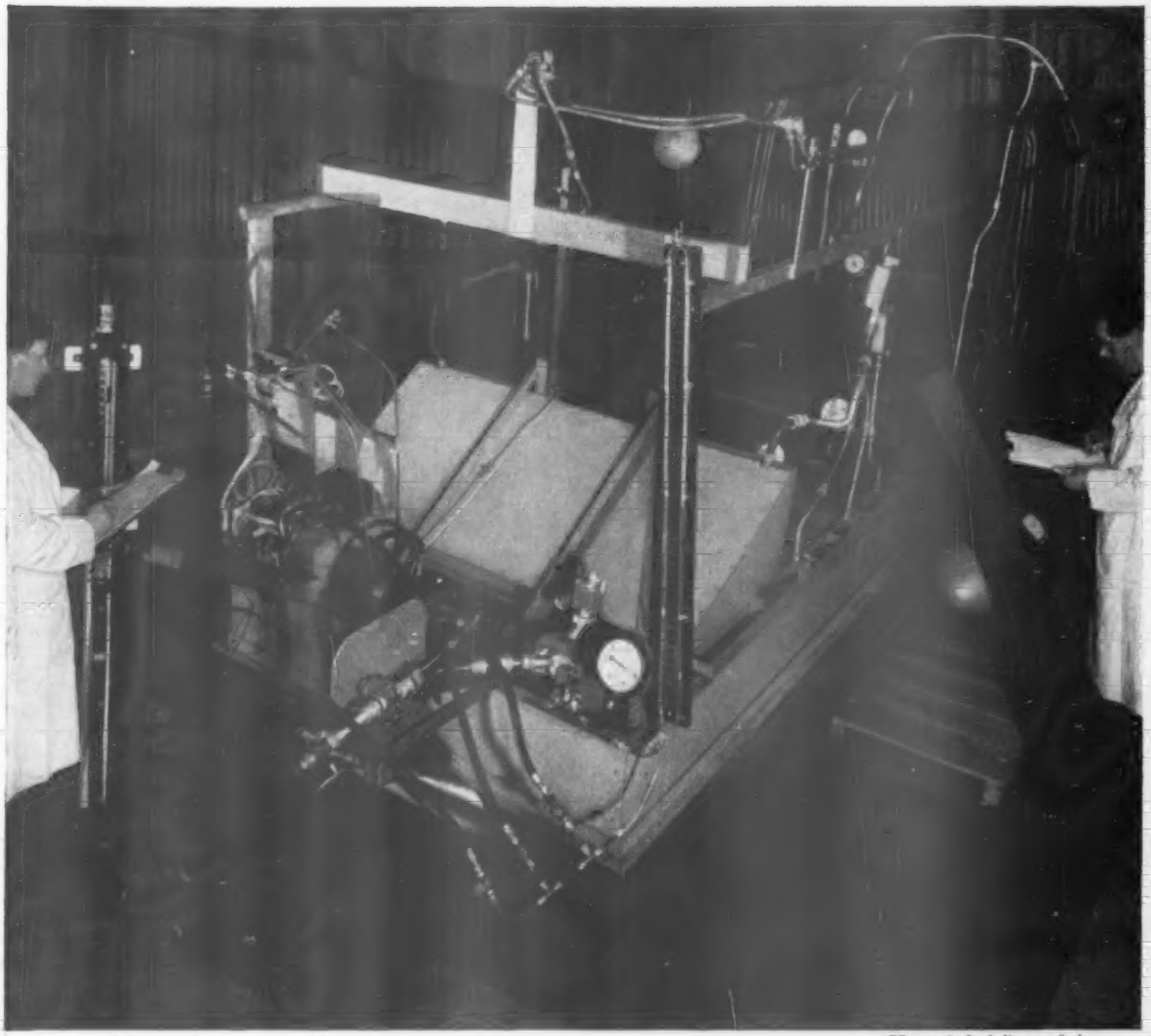
Airline passenger seats have tended to reach optima in terms of lightness and relative comfort according to the standards required. It was interesting to see, on the Lancefield stand, the latest air transport standards applied to seats for executive aircraft. Here was a single-seat unit based on the first-class twin-seat for the Comet. Its weight is 38 lb., it has nine seat-back recline positions and is designed to be mounted on runners.

Aircraft Furnishing were showing for the first time the first-class double seat in the Lonsdale range. The same chair can be used in triple form, with reduced recline (67½ deg. for 54-in. pitch), and with tables attached to the seat back. The first-class double seat weighs 55 lb.



The Lancefield executive aircraft seat which is, in effect, a single first-class Comet seat.

The Walter Kidde flight-deck emergency oxygen control panel.



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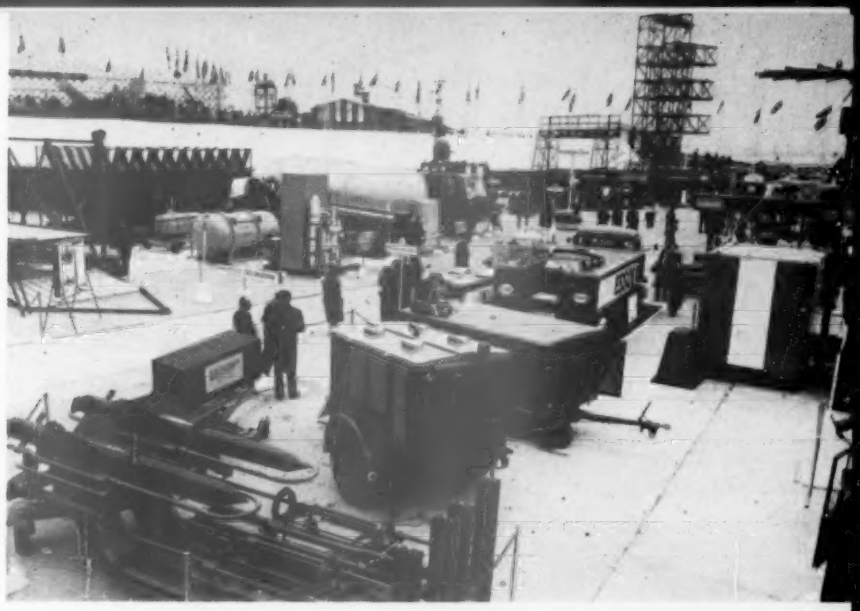
A4

Final Farnborough Report . . . .

Ground Services



Right, the outdoor site exhibition (M.L. Aviation Firestreak ground-handling trolley in foreground).

SOMETHING new in apron equipment was the Samlesbury Engineering Cargoveyor. This is, in effect, a mobile baggage/cargo terminal. It consists of a covered van with an adjustable conveyor which can be raised, lowered or extended by hydraulic rams to reach the aircraft hold. Baggage and freight items are loaded into the van at the terminal or Customs point, taken to the aircraft and, when the conveyor has been adjusted to the correct level, are placed on the belt which carries them up to a loading tray, with idler rollers, at the end of the conveyor arm. The demonstrated version operates for hatches or doors between 1 ft. 3 in. and 11 ft. 6 in. above ground level.

Another new loading device was the Short freight lift, which is in service with the R.A.F. Although large (the platform is 14 ft. by 12 ft.) and capable of lifting 8,000-12,000 lb. to a height of 12 ft., it has been designed so that it can be dismantled for air-lifting. The platform is operated through cables by an electric power pack which can be supplied by a normal servicing trolley. The entire mechanism, including the drive unit trolley and ramps, weighs 3,900 lb. when dismantled.

Above, another view of the outdoor exhibition with the Dexion servicing stand dominant in the picture.

Right, the Samlesbury Engineering Cargoveyor which is a mobile baggage/cargo loader/unloader with an adjustable conveyor arm and belt.

Airport Lighting Trends

Some of the changes in the requirements and thinking leading towards better visual guidance were to be seen on the General Electric stand. New equipment included blister centre-line (or touch-down area) runway lights, an R.A.E.-type visual glide-path indicator unit and a flasher unit for taxiway lights. The high-intensity runway lights, shown in both uni- and bi-directional form, are virtually flush, the "blister" formed by light unit being no more than $\frac{1}{8}$ in. above the runway level.

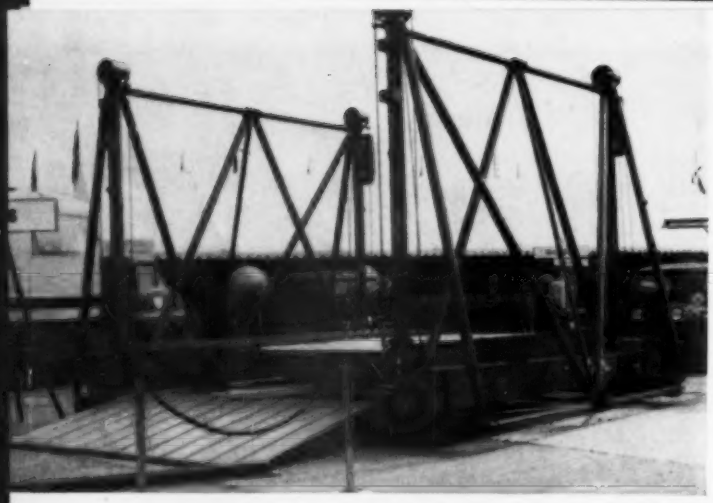
The V.G.P.I. unit (shown in $\frac{1}{4}$-scale model form) has a water-drained casing in halves of resin-bonded glass fibre. The optical components consist of a reflector/colour-filter assembly at the rear and a slit aperture at the front. At these points, where the casing needs to be assembled with very close tolerances, machined light-alloy castings are used. The whole unit is mounted on four adjustable ball joints and has an overall height of only $10\frac{1}{2}$ in. Four standard lamps are used and beams in two colours (red below and white above a given approach angle) are emitted, with a pink light at the transition angle.

The flasher unit can be plugged in between an existing isolating transformer and the taxiway light which needs to be flashed to indicate a taxiway intersection or junction.

Maintenance Equipment

In previous years Edghill have shown adjustable passenger steps. This time some rather less spectacular, but no less entirely necessary, servicing devices were shown. These were the Type 5 workstand and a wheel-change dolly for use with the Boeing 707. The workstand is hydraulically operated by hand pump (with mechanical lock) from the platform. Three types are available covering a range of working heights from 2 ft. 6 in. to 18 ft.

Taxiway and apron maintenance facilities were demonstrated by the Gloster Verro Minor suction sweeper. This employs two rotating brushes which sweep towards the vehicle's



The Short freight lift which is designed to be dismantled for air transport. It weighs 3,900 lb. and can lift up to 12,000 lb. to a height of 12 ft.

centre-line where a nozzle sucks it up into the collecting hopper. The maximum operating speed is 10 m.p.h. and it is designed so that it can work right up to walls and hangar pillars. The width of the sweep is 4 ft. 6 in.

LOX Dispensers

Liquid oxygen is becoming increasingly used for military aircraft and its application for emergency passenger supplies in turbojet aircraft may introduce the need for intermediate airport ground-topping-up supplies. Presumably the problem in the case of civil aircraft will be tackled by the replacement of storage-converter units, as necessary, at staging points. In military aircraft the equipment is usually inaccessible and as oxygen is being used on all flights, supply dispensers have to be provided.

British Oxygen were showing, on their outdoor site, both mobile apron dispensers and big-capacity insulated static storage tanks. The former were the 50-gallon mobile unit in service with NATO and a 20-gallon mobile dispenser in service with the R.N. and R.A.F.

GPUs and APUs

Among ground power equipment in the outside display at Farnborough was the latest version of the Rover GPU based on the 1S/60 gas turbine. This unit normally supplies electric power and low-pressure air, but there is provision for the supply of hydraulic power. The unit is not itself mobile, but its overall weight is low (520 lb., dry) and it can be conveniently palleted for airlift.

Rover were also showing a new APU—for the A.W.660 military transport. This unit is used for engine-starting (by means of a 9 kW. Rotax generator), for general ground checking, for the hydraulic operation of doors, winches and loading systems, and for the supply, when airborne, of emergency hydraulic and electric power. The hydraulic pump supplies 5.5 Imp. gal./min. at 2,600 p.s.i. This APU weighs 310 lb. (dry) and has a basic power rating of 65 b.h.p. in standard conditions. With normal fuel the unit operates up to 25,000 ft. and can be started at 15,000 ft.; a special fuel system will permit starting at 45,000 ft. and operation up to 50,000 ft. It is enclosed in a fireproof nacelle within which engine cooling is maintained by a two-stage axial blower.

Survival Equipment

VERY much in the news during this year's S.B.A.C. display, VTOL has been occupying the minds of the survival experts for some time, and active experimentation is in progress to achieve consistently safe ejections and parachute deployment from zero airspeeds and zero height. In the Short SC.1, which provided the main attraction in the flying display, Martin-Baker Aircraft have such an ejection seat, but only because of the comparatively low maximum speed involved, of 300 knots.

For escape from low and slow aircraft, virtually no delay in seat separation and parachute deployment is permissible, and in the SC.1 seat the normal drogue gun is used to extract the 'chute canopy, by-passing the drogue system, and having a considerably heavier "bullet." At high speed, such a system would burst the parachute canopy or at least injure the pilot through excessive deceleration, and is therefore unsuitable for the faster VTOL types.

Rocket-propelled ejection is now being studied in Britain to obtain the high trajectory for parachute deployment under "zero-zero" conditions. Rockets are already in use in certain U.S. ejection seats, but their use poses many problems, particularly of aligning the thrust (to prevent tumbling) precisely through the C.G. of the mass of a seat adjustable in height.

In the meantime, Martin-Baker showed in an interesting film at Farnborough, that two rockets, each of 800 lb. or so thrust, give a trajectory of about 250 ft. when employed after normal long-stroke ejection-gun firing, for zero-zero parachute deployment, using the duplex drogues. Parachute extraction starts during the upward component of the trajectory, and is aided by the horizontal motion imparted by the rockets.

The film also showed a dummy ejection at 200 ft. from the firm's Hunter T.7 flying at the very high I.A.S. of 605 knots. Adequate fin clearance was obtained, with rapid separation and deployment, despite the delay imposed by the *g*-controller to allow for deceleration. Progressively greater tail clearance was shown during other ejections at slower speeds, including a live descent by Mr. W. T. Hay at 250 knots from a Valiant, and a runway ejection (of a 400-lb. ejected mass) at 90 knots from a Meteor 7.

Hardware shown by Martin-Baker this year was the interesting Mk. GQ 5 seat developed specifically for the Lockheed F-104G Starfighters for the German, Belgian and Dutch air forces. The shallow ejection angle in the F-104 (about 12° instead of the normal 20), necessitates a much thinner parachute pack and seat assembly to keep the pilot at a reasonable seating angle. Adapted from the Mk. 5 series for other American aircraft, the GQ 5 incorporates all the usual Martin-Baker features of face-blind and seat-pan firing, 80 ft./sec. telescopic gun, duplex drogues extracted by a drogue gun, combined parachute and seat harness, personnel equipment connector and an Irvin canopy stowed in the horseshoe-shaped Fibreglass-sided pack.

It has manual seat height adjustment, and a new swinging safety lock on the seat-pan handle, instead of the usual pin. A more positive top latch is fitted, and the blind handle is now rigid instead of flexible. A cartridge-operated guillotine is fitted to cut the drogue line for manual release from the seat, and the actuating handle on the seat pan also unlocks the harness. The Mk. GQ 5 seat is cleared for ejection between 80 and 640 knots, I.A.S., down to zero height, and it may be recorded that of nearly 400 safe emergency ejections achieved so far with Martin-Baker seats, only 14 have been at more than 500 m.p.h.

Folland Aircraft are also concerned with rocket propulsion for ejection seats, with which experiments are in hand, the immediate task of developing a zero-height seat for use down to 90 knots having been achieved. The Folland Mk. 4G seat, as in the Gnat Trainer, was again shown this year, and obtains runway capability via a q-selector operating from the pitot system. Below 300 knots, a change in the separation delay after ejection is automatically made from 1.25 sec. to 0.25 sec., and the 80 ft./sec. combined seat-rails and ejection gun ensure a suitably high trajectory.

A new Mk. 2 combined harness is fitted, with an additional strap for negative *g* restraint passing between the thighs into a three-point quick-release box, with plug-in shoulder harness. Common features with the Martin-Baker seats include face-blind or seat-pan firing and leg restraint straps, but the Folland unit differs in having pilot- instead of seat-stabilization, with a six-foot drogue on the GQ 18 ft. 6 in. lightweight canopy.

The GQ Parachute Company themselves were showing for the first time a 66-ft. parachute assembly for the dropping of very heavy loads, and a cluster of eight was used for the recent record figure of 40,000 lb., from a Blackburn Beverley. Originally designed for a 3,000-lb. load, the 66-ft. canopies are proving capable of handling twice that figure. The 66-footers are assembled in five segments from 1,000 sq. yd. of synthetic fabric, and each contains 3,000 yd. of rigging lines.

Irving Air Chute of Great Britain, Ltd., had an LB4/1 ribbon tail parachute for the Bristol 188 in a conical rear-fuselage pack, and an MBEU C19 PA horseshoe pack for Martin-Baker ejection seats on show. A special ES 63/1 all-nylon seat-pack and harness, with lightweight canopy, built-in oxygen and barometric release, was developed for the Potez Air-Fouga Magister or other high-flying fixed-seat aircraft. A training main and chest parachute for sporting use completed the display, although there was a reminder that the instrument capsule from the Discoverer XIII satellite had been recovered after re-entry by an Irvin parachute.—J.E.F.

Correspondence

Pre-war Junkers Still Flying

IN your issue of Aug. 19, 1960, you referred to the recent loss in accidents in Canada of two distinguished veteran aircraft, the Junkers F34, CF-AQW, and the Barkley-Grow T8P-1, CF-BLV. You say that both these aircraft were "virtually unique" but I believe I am right in saying that there are at least two other W34s (or F34s?) still airworthy based at Sea Island Airport, Vancouver. I enclose photographs of these aircraft (CF-AQB and CF-ATF) which I took in Vancouver last February, together with one of the Supermarine Stranraer which was being rebuilt and another of an elderly Fairchild F.71, CF-BXF.

Ruislip, Middx. PETER W. BROOKS.

The Near Miss at Rome

I HAVE read with interest the article (Aug. 19, 1960) concerning the near miss between two aircraft over Rome recently. I was struck particularly with the phrase written by Wg. Cdr. T. D. Calnan saying that "it is possible that he (meaning Clipper 114) thought that Oscar Papa was at a flight level higher than 8,000 ft," and the fact that this was not followed by further comment along these lines.

From my own experience at sea in various operations probably the biggest problem of control is that of knowing exactly where the other fellows—in those cases, ships—are. I was surprised, therefore, to find no evidence in the article of any effort to inform Clipper 114 of the movements of Oscar Papa after he, Clipper 114, had changed over to the tower frequency at 11.34, only seconds before Oscar Papa was ordered to alter his height.

To my mind this is a serious omission. I know little about airport control, and as little about the pilot's ability or inability in the busy moments of landing his aircraft to receive "Situation reports" concerning the movements, particularly the heights, of other aircraft around the airport, but I can't help feeling that such information would help a lot a pilot in the situation that the pilot of Clipper 114 was at 11.35 on the day in question.

Londonderry. "AVIATOR."

Icing Investigations

I WAS interested to see a letter (Jne. 24, 1960) dealing with early experimental activities of the B.E.A. I think, however, that Mr. Dennis Powell has got some of his information a bit mixed up. The investigation into dangerous icing conditions was to the best of my recollection carried out by Capt. Mason using Viking aircraft. The D.H. Mosquitoes were flown by the Clear Air Gust Research Unit, and were not at any time used for icing investigation. I have good reason to remember this since I myself belonged to the Gust Research Unit between the years 1948 and 1950.

The captains concerned were Capt. T. T. Thomas and Capt. D. F. Wilson. Capt. Wilson is still with B.E.A. based at Jersey, although Capt. Thomas was regrettably killed in an aircraft lost over southern Italy some years ago (not a B.E.A. aircraft).

The two Mosquitoes concerned were G-AJZF and G-AJZE. They must be unique in having obtained civil certification if only in a special category.

Hayes, Middx. D. M. DAVIES.

Wroundabout Farnborough

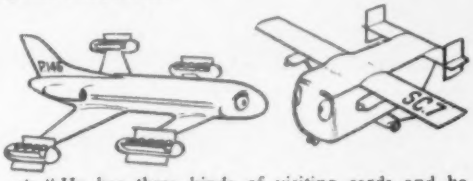
Almost inevitably, technical talk deteriorated into weather talk at the S.B.A.C. Display—"When you can't see across the runway, it's raining—when you can, that means it's *about* to rain." All the same, Monday was marvellous. One character, this one, said he was having a "perfect Farnborough."

"the perfect Farnborough.."

✱ Tuesday was as bad as Monday was good, so after lunch I went home and watched the flying in comfort, on TV. In future years, faced with the prospect of unbearable noise and unspeakable weather, the company enclosures will probably go to earth in the hill on which the exhibition stands and we'll see the flying on infra-red TV.

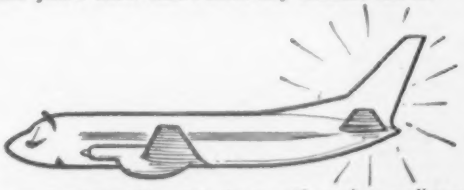
✱ In the exhibition I came across a rare sight—our old friend J. H. "X-Ray-Eyes" Clark on the job, sketching the inside works of the Bristol Siddeley Stentor rocket. I couldn't resist a quick impression, thinking all the while that all that was now needed was to get Charles Sims to photograph Wren sketching Clark—and the Editor to report the scene.

✱ Ben Gunn, Boulton Paul chief test pilot, took me to their stand and pointing to their P.146 model, said: "Chris, this is to show you that there's nothing you can draw that we haven't already thought of." Obviously Short's, who have had the bizarre design market pretty much to themselves for years, are up against competition.



✱ "He has three kinds of visiting cards and he knows exactly how to play them all."

✱ A TV commentator said this was the 95th S.B.A.C. Display. Actually, it only *seems* like it, and by the time the 95th one *does* come around, the letters S.B.A.C. may mean not "Society of Both Aircraft Constructors" but "Single British Aircraft Constructor." But in spite of all the mergemanship this year's show didn't *seem* any smaller, did it?



✱ Aesthetic Gimmick Dept.—That oh-so-ordinary look of the Avro 748 might be given a *soupçon* of *je ne sais quoi* by sweeping the tail and perhaps a *leetle* touch of dihedral on the tailplane, yes?

✱ The British Oxygen sales chaps looked consistently sparkling fit in spite of the exhibition's wear and tear. The reason? "SPOD," they said—"Sniffa Pinta Oxygena Day."

by Gordon

Industry Record

Radio Navigation Symposium

The AGARD Avionics Panel is to present a symposium on "Radio Navigation" in conjunction with the 10th AGARD General Assembly to be held in Istanbul from Oct. 3 to 9.

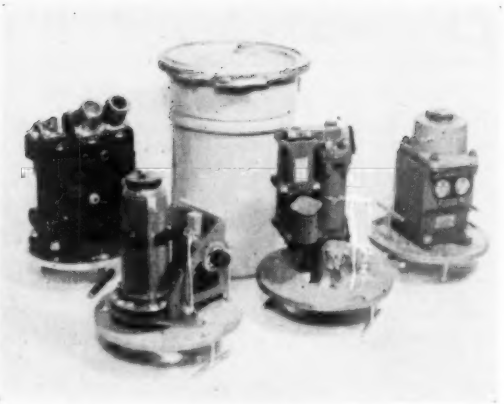
A good coverage of the navigation field is expected with the presentation of some 35 technical papers and the ensuing discussions. The first day of the symposium will cover general problems concerned with navigation which will include papers on wave propagation. The second day will be devoted to radio navigation including Doppler and air traffic control.

Space and astro-navigation will be discussed on the third day, and display methods and automatic approach and landing on the last day.

Data Processing Service

De Havilland Propellers, Ltd., have now set up at their factory at Stevenage an organization which can perform data processing on a commercial basis.

Trained operators and duplicate sets of equipment at the factory can rapidly and accurately transfer raw data from strip chart records on film or paper on to standard punched cards, punched paper tape, or into tables. The punched cards or tape may then be fed into a suitable computer elsewhere. Alternatively, if the information is presented on punched cards or tape it can be automatically displayed, up to 6 variables being plotted together on a common base scale. Handling rates in either case are normally in excess of 800 points per hour.



Seaslug components are transported to Woomera and other locations in a number of special containers similar to the one on the right. These re-sealable packs accept a standard circular mounting plate, which carry the various missile units, and are filled with dry nitrogen.

Publications Received

The History of Australian Aviation. A detailed account, with much hitherto unpublished material, of the development of aircraft construction, service and civil flying in Australia from 1851 to 1960. By Stanley Brogden. 192 pp.; 5¼ in. x 8¼ in. Illustrated. The Hawthorne Press. Price 35s.

Holidays in Boats (2nd Edition). A guide for those planning a boating holiday on Britain's inland or coastal waters or on the Continent, by F. H. Snoxall. 148 pp., 4¼ in. x 7¼ in. Illustrated. Temple Press Limited. Price 8s. 6d.

Blackburn Engines, Ltd., have recently delivered low-pressure air starter trucks to Prestwick Airport, one of which is seen here starting a T.C.A. DC-8. They consist of a Bedford vehicle carrying a Palouste starter unit in the form of a pack. This pack is air transportable and may be used separately on the ground.

Aviation Calendar

Sept. 16

Oxford.—Institute of Transport Week-end Course at New College; until Sept. 19.

Sept. 17

Battle of Britain "At Home" day. Twenty-five R.A.F. stations are open to the public.

Sheffield.—Norton Air Show.

Sept. 25

Dunstable Downs.—National Aerobatic Contest organized by the London Gliding Club at 11.00 hrs.

Sept. 27

London.—The Institution of Mechanical Engineers Symposium on Automatic Control; until Sept. 28.

Sept. 28

London.—Society of Environmental Engineers lecture, "The Development and Testing of Small Electronic Components," at Imperial College, S.W.7, at 18.00 hrs.

London.—Northampton College of Advanced Technology start of 1960-61 session of post-graduate lectures in Aeronautical Engineering, at the College, St. John Street, E.C.1. Full details can be obtained from the College.

Oct. 3

Istanbul.—AGARD 16th meeting of the Aero Space Panel; until Oct. 8.

Istanbul.—AGARD 4th Avionics Panel Symposium on "Radio Navigation"; until Oct. 9.

Oct. 6

Istanbul.—Tenth AGARD General Assembly; until Oct. 7.

Bristol.—British Institution of Radio Engineers convention on "Aviation Electronics and its Industrial Applications," at College of Science and Technology, Ashley Down Road; until Oct. 7.

Oct. 11

Folkestone.—Aerodrome Owners Association Annual Conference, at the Grand Hotel; until Oct. 12.

Oct. 12

Brighton.—Institution of Production Engineers Conference on "Modern Trends in the Manipulation of Metals"; until Oct. 14.

Oct. 18

Bournemouth.—Guild of Air Traffic Control Officers 3rd Air Traffic Control Convention, at the Town Hall; until Oct. 19.

New Patents

APPLICATIONS ACCEPTED

851,379.—**Power Jets (Research & Development), Ltd.** — "Aircraft." — Nov. 20, 1958. (Nov. 20, 1957.) (Addition to 829,753.)

851,428.—**United Aircraft Corporation.**—"Fuel-supply system for use in aircraft."—Inc. 19, 1958. (Aug. 28, 1957.)

851,510.—**Short Bros. & Harland, Ltd.**—"Aircraft adapted for vertical take-off and landing." —Apr. 7, 1959. (Apr. 18, 1958.)

851,920.—**Hobson, Ltd., H. M.**—"Feel simulators for aircraft."—May 6, 1959. (Feb. 12, 1958.) (Addition to 734,437.)

851,916.—**Power Jets (Research & Development), Ltd.** — "Aircraft." — Dec. 12, 1958. (Oct. 21, 1957.)

Printed specifications of the above will be available on Oct. 19, 1960, and the opposition period will expire on Jan. 19, 1961.

Company Notices

NEW COMPANIES

R. E. Zeiher, Ltd. (688,157).—Private co. Reg. Aug. 19. Cap. £100 in £1 shs. Aerial comunication. Directors: R. E. Zeiher and Mrs. J. D. Zeiher, both of Brook House Cottage, Knightsbridge Road, Camberley, Surrey. Sec.: Josephine D. Zeiher. Reg. off.: Brook House Cottage, Knightsbridge Road, Camberley, Surrey.

OVERSEAS COMPANIES

Japan Air Lines Co., Ltd. (F.4934).—Particulars filed Aug. 9, 1960, pursuant to Section 407 of the Companies Act 1948. Reg. in Japan in 1952. British address: SAS House, 52/3 Conduit Street, W.1. Directors: Seyiro Yanagota, Shizuma Matsuo, Yoshito Kojima and 12 others (all resident in Japan).

INCREASE OF CAPITAL

Hawker Siddeley Group, Ltd. (302,913), Richmond Road, Kingston, Surrey.—Increased on Feb. 5, 1960, by £12,000,000 in £1 ordinary shares, beyond the reg. capital of £45,000,000.

Personal Notices

BIRTHS

Beck.—On Sept. 1, to Pat, wife of Flt. Lt. K. F. Beck—a daughter.

Burgess.—On Aug. 28, at Holyhead, to Mona (*née* Smith), wife of Flt. Lt. J. N. Burgess—a daughter.

Fraser.—On Aug. 28, at R.A.F. Hospital, Wroughton, to Sheila, wife of Flt. Lt. M. Fraser—a son.

Gough.—On Aug. 28, at R.A.F. Hospital, Ely, to Yvonne (*née* Cory), wife of Sqn. Ldr. V. A. Gough—a daughter.

Ince.—On Aug. 28, at Westwood Hospital, Beverley, to Pamela (*née* Archer), wife of Flt. Lt. J. G. Ince—a son.

Mavor.—On Aug. 27, at R.A.F. Hospital, Nocton Hall, to June (*née* Blackburn), wife of Gp. Capt. L. D. Mavor—a son.

Watkinson.—On Aug. 28, at Jever, Germany, to Rhiannon, wife of Sqn. Ldr. H. H. Watkinson—a son.

Wright.—On Sept. 3, at the Maternity Hospital, Mill Road, Cambridge, to Ann (*née* Hart), wife of Sqn. Ldr. David Wright—a son.

DEATHS

Jones.—On Aug. 29, at Morriston Hospital, Wg. Cdr. James Ira Thomas Jones, D.S.O., M.C., D.F.C., M.M.

Newton.—On Aug. 7, at St. Matthew's Nursing Home, Northampton, Margretta Jane Newton, M.B., Ch.B. (Edin.), wife of Charles Newton and mother of Michael Newton, Burma Shell, Karachi.

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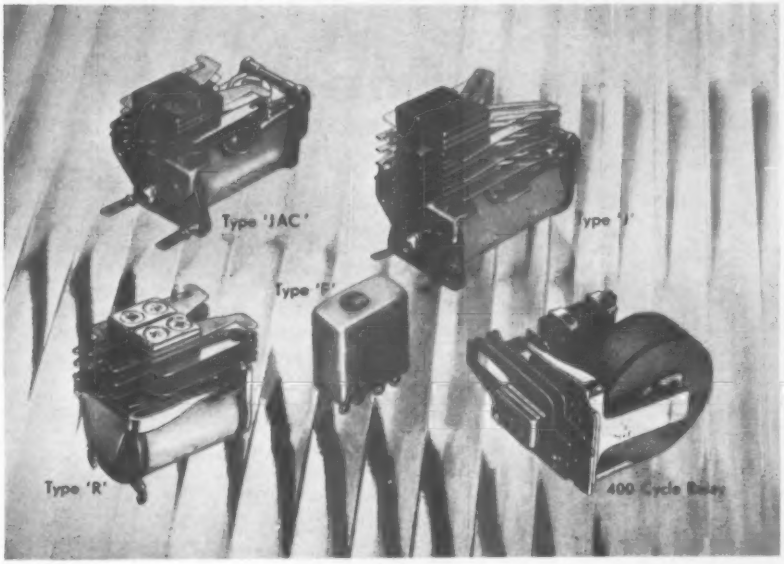

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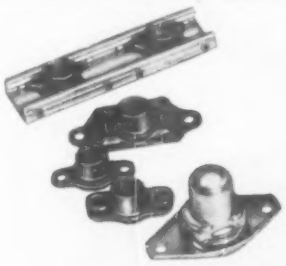

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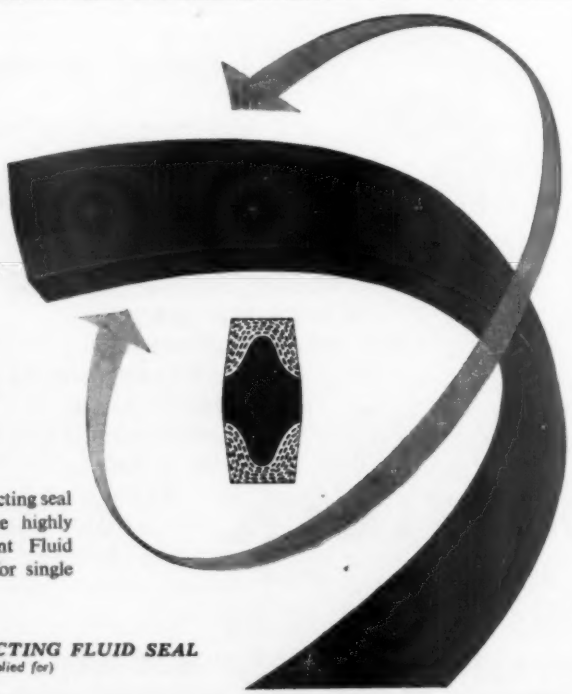

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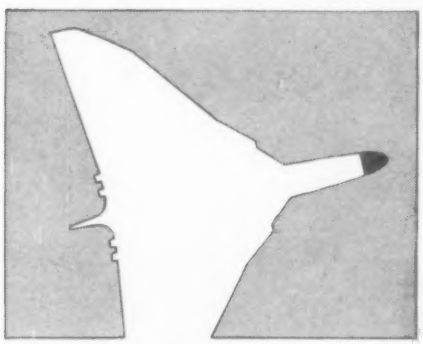

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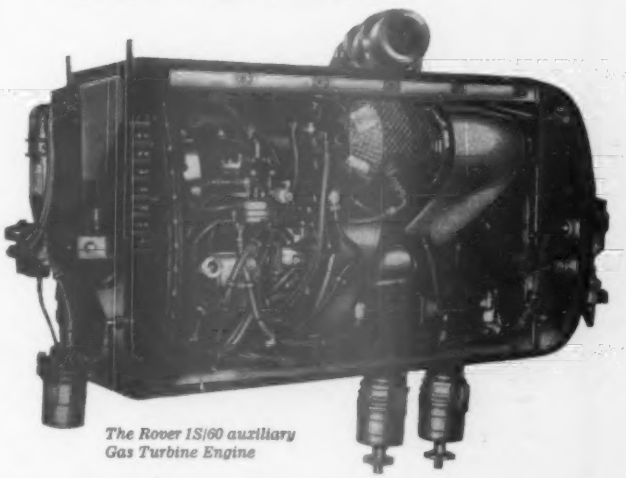

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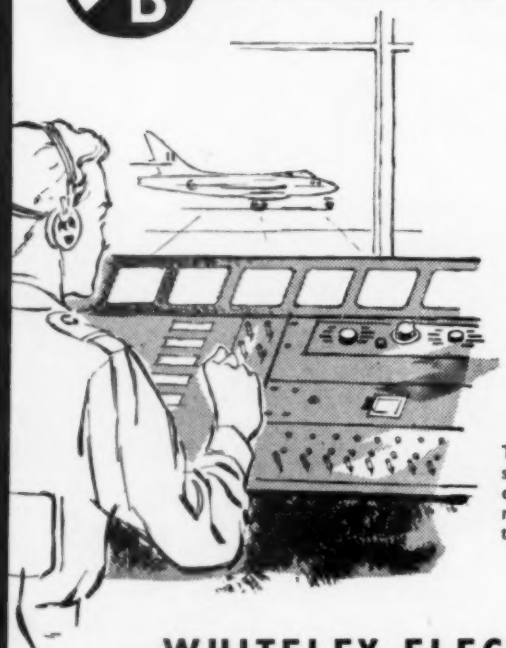

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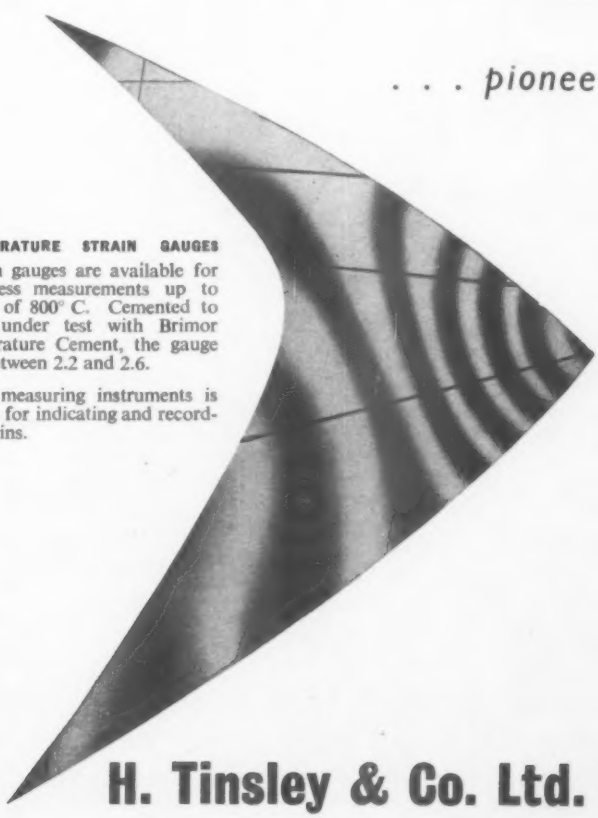

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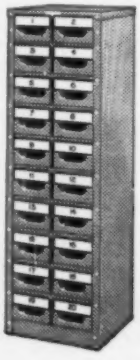

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FROM SILVER CITY AIRWAYS, LTD., OF 62 BROMPTON ROAD, LONDON, S.W.3., unless otherwise stated for Normal Scheduled Services, initially with Dakota and Hermes aircraft and later also with Viscount aircraft, for the carriage of passengers, supplementary freight and mail at an initial frequency of seven return flights weekly, on each service, increasing later in accordance with traffic demand, for seven years from March 1, 1961:—

APPLICATION NO. 4466 for a U.K. Internal Service with Dakota aircraft only, between Leeds/Bradford Airport and Newcastle for seven years from the date of approval.

APPLICATION NO. 4467 between Newcastle and Le Touquet.

APPLICATION NO. 4468 with Dakota aircraft only between Leeds/Bradford Airport and Le Touquet, at an initial frequency of 10 return flights weekly, increasing later in accordance with traffic demand.

APPLICATION NO. 4469 on the route Glasgow and/or Edinburgh-Le Touquet.

APPLICATION NO. 4473 between Birmingham (Elmdon) and Le Touquet.

APPLICATION NO. 4474 on the route Blackpool and/or Manchester and/or Liverpool-Le Touquet, at an initial frequency of 10 return flights weekly increasing later in accordance with traffic demand.

FROM ORION AIRWAYS, LTD., OF GATWICK AIRPORT, HORLEY, SURREY, for the following Normal Scheduled Services, initially with Viking aircraft and later also with Viscount aircraft, for the carriage of passengers, supplementary freight and mail, at an initial frequency of 10 return flights weekly on each service, unless otherwise stated, increasing later to 20 return flights weekly, for seven years from January 1, 1961:—

APPLICATION NO. 4470 between London (Gatwick) and Frankfurt.

APPLICATION NO. 4471 between London (Gatwick) and Paris (Le Bourget), at an initial frequency of two return flights daily, increasing later to 20 return flights weekly.

APPLICATION NO. 4472 between London (Gatwick) and Munich.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 552-3

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